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The first part of this monograph represents the proceedings of a 1-day conference of manpower analysts on the processes by which private industry meets changing manpower requirements and the implications of these work force adjustments for manpower policy. The second part consists of the report on which the conference discussion was based. The report is a summary of two doctoral dissertations prepared under grants from the Manpower Administration and is entitled, "Internal Labor Markets, Technological Change, and Labor Force Adjustment," by Peter Doeringer and Michael Piore. The internal labor market is an administrative unit, within which are performed the market functions of pricing, allocating, and often of training labor. It is governed by a set of institutional rules covering recruitment procedures, training, compensation, and the like, over which the employer exercised discretionary control. These internal mechanisms constitute the alternative modes of adjustment to changes in both production techniques and labor market conditions. Implications of the internal market are discussed in relation to federal programs of job training, recruitment and screening, coordination of public and private training programs, and governmental manpower planning and labor force adjustment programs. A bibliography lists over 100 sources. (ET)

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WORK FORCE ADJUSTMENTS IN PRIVATE INDUSTRY - THEIR IMPLICATIONS FOR MANPOWER POLICY

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WORK FORCE ADJUSTMENTS IN PRIVATE INDUSTRY-THEIR IMPLICATIONS FOR MANPOWER POLICY

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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U.S. DEPARTMENT OF LABOR
Willard Wirtz, Secretary

3 MANPOWER ADMINISTRATION
Stanley H. Ruttenberg, Manpower Administrator

FOREWORD

The conference which is reported on in the first part of this monograph represents a promising experiment in utilization of research results. It was concerned with the major substantive findings and policy implications of the report which comprises the second half of the volume.

The report which follows is a summary of two doctoral dissertations written in the Department of Economics, Harvard University, under grants from the U.S. Department of Labor. One, by Peter B. Doeringer, was entitled *The Theory of Internal Labor Markets* and the other by Michael J. Piore, was entitled *Technological Change and Structural Imbalances in the Labor Market.* The two studies profited from a good deal of joint field work in a number of manufacturing plants. This report is designed to present the research design and methods, the analytical concepts developed, the results and findings, and the implications for policy of these two related studies.

These studies were begun in a period of widespread public concern with a possible growing imbalance between the characteristics of the work force and the changing nature of job requirements as influenced by technology. These studies are completed in a period of high aggregate demand when the fears of imbalance of an earlier period seem in the main unwarranted. This experience focuses attention on the process of interaction and adjustment between the labor force and job requirements and the "costs" of these adjustments. This study makes a significant contribution, in my view, to the understanding of these processes as they apply to blue-collar manufacturing-type jobs, particularly in larger sized establishments.

These dissertations have elaborated and applied the concept of an internal labor market to make it a significant tool of analysis, bridging the too often isolated worlds of industrial relations and personnel on one hand, and economic analysis on the other. Not only does "the internal labor market" help to illuminate and to organize the interrelations between technological change and the labor force, the central problem of these studies, but the concept may also be applied to provide significant insights into a number of other questions: the meaning and definition of labor scarcities, seniority rights and equal employment opportunity standards, managerial manpower planning and forecasting, labor costs pressures, and a variety of industrial relations issues. The concept brings the discussion of inflation, labor shortages, and costs back to the microlevel of analysis that has often tended to be overlooked in the preoccupation with the general level of economic activity. It suggests why manpower policies at the enterprise and aggregate levels are necessarily concerned with both labor shortages and surpluses. It helps us to understand and to appreciate how rich and variegated are the processes of adjustment and interaction of manpower and job requirements.

John T. Dunlop
Harvard University

PREFACE

This monograph is one of a series published by the Manpower Administration of the U.S. Department of Labor on research conducted under title I of the Manpower Development and Training Act of 1962.

The first part of this monograph represents the proceedings of a conference on the processes by which private industry meets changing manpower requirements and the implications of these work force adjustments for manpower policy. The conference was sponsored by the Manpower Administration of the U.S. Department of Labor.

The second part consists of the report on which the conference discussion was based. This report is a summary of two doctoral dissertations prepared under grants from the Manpower Administration.

Researchers undertaking research projects under Government sponsorship are encouraged to express freely their professional judgment. Points of view or opinions stated in the dissertation summary or by participants in the conference are not to be construed as official opinions of the U.S. Government or of the U.S. Department of Labor.

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CONFERENCE ON WORK FORCE ADJUSTMENTS IN PRIVATE INDUSTRY AND THEIR IMPLICATIONS FOR MANPOWER POLICY

Washington, D.C.
May 18, 1967

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MORNING SESSION

OPENING REMARKS

Curtis C. Aller, Associate Manpower Administrator
Arnold Weber, University of Chicago

DR. ALLER: The Manpower Administration is, as you know, engaged in the support of manpower research, largely through contracts with universities and other organized research institutions. This represents a departure for the Department of Labor, and our concern is to use our limited resources as effectively as we can. First, of course, we must try to select the areas of research priorities with the greatest potential from the standpoint of policy development. Our second concern is to secure competent basic research. And our third is to make effective use of the research results.

We are presently trying to determine or discover effective ways of utilizing the research; we are also undertaking experimental and demonstration work. These activities are innovative. In a sense I conceive of the people involved in them as brokers of ideas. Their job is not only to try to discover effective ways of suggesting policy for, and implications of, research and experimental and demonstration work, but to discover how to get these ideas to the attention of people who may be in a position to act on them. And I might say that we have thought of effective utilization of research in terms of publication in books and articles, talks at annual meetings, and the kind of discussion we are having here today. Discussion is a very useful device, a kind of market test; the printed publication is very slow in terms of stimulating use for policy development. Too often, the ideas become part of literature of the subject and are studied by undergraduate and graduate students, who years later, in one institution or another, may be in a position to utilize them for policy development.

Our concern is to short-cut that kind of lag; to find, if we can, quicker ways of putting available research products into the mainstream of policy making—in our case, Government policy making. This conference represents part of our effort to discover the most effective ways of bringing research results not only to the attention of people in Government but those outside.

I might say that, to me, the work we are discussing represents a very exciting development. I can recall hearing the precursors of some of this work in seminars at Harvard back in 1948; now, 15 or 17 years later, we have a culmination of that. It is very timely to sit down together and talk about the relationship of these findings to manpower programs and economic policy.

Not to limit discussion, but to suggest the range of things we may want to talk about, I want to read a list of possibilities that have occurred to us. First, for example, what are the implications of the notions of the entry port for placement activities, and for job vacancy data collection and research? We are still in the wilderness in terms of trying to get large-scale support for regular job vacancy data collection programs. Meanwhile, we are undertaking considerable research on various aspects of this subject, and it may be useful to think of this research project in terms of possible meanings for future development of job vacancy work.

Second, who should bear the cost of on-the-job training, formal as well as informal? I might mention that we are organizing a high level task force of public, industry, and labor representation through the Departments of Labor and Commerce, for the purpose of trying to look at what I call the appropriate public and private roles in the whole area of occupational trends. And long overdue is a look at the implications of our early development of on-the-job training as a Government program. What are some of the consequences of that program in terms of private training effort? May there not be alternative and more effective ways of involving the private sector in our total occupational training effort?

In a sense, what we hope to strive for during the balance of the year is something approaching consensus on public policy in this area, leaving for later development the details, legislative proposals, or administrative decisions that might be needed. So, this research is timely in terms of broad questions we will be asking during the balance of this year.

Third, do manpower planners and policy makers underestimate the capacity of the private sector to effect labor force adjustments? This is a very real question. As a matter of fact, we have begun to pay greater attention in recent months to the employer part of broad manpower problems. Basically, as you know, through manpower development and training activities, we have been fundamentally retuning the labor supply, trying to teach the attitudes, skills, and knowledge acceptable to employers. Frank Cassell, the Director of the United States Employment Service,[1] has pointed out that this misses the larger part of the problem. He has suggested that our real problem is discovering how the employer can accommodate to, adjust to, and use effectively those unemployed workers who are now going through our training programs. He believes that if we were to direct our research and policy attention to the employer's side, it would be possible to achieve more effective utilization of the excluded members of the labor force, without the cost now involved in large-scale occupational or skill training through organized institutional training programs. There are many aspects of that, and I hope to come back to them during the course of the day.

Fourth, what do we know about private sector adjustment activities and how can such knowledge improve manpower programs?

And, fifth, does dividing the labor market into an internal and external market provide a useful research tool?

Now, may I welcome Arnold Weber, chairman for this morning, and turn the meeting over to him.

Dr. Weber: Thank you very much. The focus of our discussions will be the report prepared by Peter Doeringer and Michael Piore, under a Manpower Development and Training Act grant. The report, entitled Internal Labor Markets, Technological Change, and Labor Force Adjustment, has opened up new areas of research and policy considerations.

Although there were two separate studies, they complemented each other nicely. One, Peter Doeringer's, focused on the theory of internal labor markets; the other, Michael Piore's studied various empirical aspects of technological change and labor force adjustments to this change. In effect, the internal labor market constitutes the arena within which adjustments to technological change take place. As the authors have indicated throughout the report, and as John Dunlop specified in his prefactory remarks, there are two levels of significance of this approach. One is the concept of the internal labor market. Although this concept has been around for several decades, it has not heretofore been given systematic treatment in the sense of an attempt to identify and bring together in a coherent system the primary variables and operational aspects of the labor market. Secondly, for policy purposes, much of our thinking has been on an aggregate level. The concept of the internal labor market provides an empirical basis for disaggregating the problems of labor market adjustment, an approach with which I am particularly sympathetic. The initial stage of the program this morning will be devoted to brief statements by the three principles involved. First, John Dunlop will give us a broad overview of the concept of the internal labor market and its role in labor force adjustments.

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[1] Since the date of the conference, Charles E. Odell has become Director of the U.S. Employment Service.

A BROAD OVERVIEW

John T. Dunlop, Harvard University

DR. DUNLOP: May I begin by noting that the Manpower Administration dissertation program is helping not only to attract young scholars to manpower research, but also is encouraging summarizing of dissertation work for distribution and comment by such means as this conference. I am very glad to see this innovation.

It is important to recognize that training and the development of a labor force, in the main, are to be conceived as a part of the production process. The labor supply side seems to have been treated separately, as if it somehow belonged primarily to training directors and to the vocational school system. This separation was particularly true in periods of high employment. But if we are going to live in a world of high employment, the simple fact is that manpower development and training is an integral part of the production process; decisions on production and manpower are highly interrelated and cannot be separate. This is a fundamental truth of the Doeringer-Piore studies. I like the idea of an internal labor market because, intellectually, it helps to bring together economic and industrial relations, which are too frequently separated. While seniority systems belong to the area of industrial relations, they are also a way by which manpower is moved and developed in collective bargaining systems. This approach helps tie together economics and industrial relations.

A second point: As I get around the country and talk with people, one critical question raised is whether we have entered a full-employment economy as a more or less permanent structural change in our society. There are a few believers, but most are unbelievers. We cannot readily estimate the great institutional changes that would take place in our business world, in our unions, in our other institutions, if people become persuaded that something like a 3- to 4-percent unemployment rate is normal for the future. Probably the only way to persuade people is another 5 or 10 years of high performance. I wish we had time to go into the enormous changes in policy making that would follow from a recognition of the fact that this is not a temporary 1955-56 period, or a Korean War or World War II period, but is a normal state. For instance, the view on the temporary or permanent nature of high employment affects the size of admissions to apprenticeship programs; it affects the importance of training and development in an enterprise and an industry; it influences hiring standards; it influences wage expectations. Indeed, it has to do with every aspect that touches manpower.

A third point concerns the crucial importance in our society of having a job. Once you have a job in industry, office work, or transportation and so on, many things follow. Adjustments take place in the enterprise; adjustments take place in the labor force. This underscores the importance of preparing people to get a first job, and I think this defines a major priority for public policy.

A fourth point that everyone should bear in mind is that here today we are talking about larger scale enterprises. The world of the small enterprise needs to be explored a great deal more than was done in the work of Doeringer and Piore, although they looked at some small enterprises. Many things I said a moment ago are peculiarly applicable to larger enterprises. But a significant fraction of the labor force is in small enterprises, and manpower development in this area needs exploration.

Now, my colleagues will summarize their studies. I am especially interested in the implications for policy and the avenues for further work that are indicated by their report and I'm sure we'll return to these themes.

THE INTERNAL LABOR MARKET AND INTERNAL TRAINING

Peter B. Doeringer, Harvard University

Dr. Doeringer: Thank you. When we began our research we were interested in analyzing the impact of technological chage upon the content of production and maintenance jobs in manufacturing. As interviewing progressed, however, it became increasingly clear that we were observing a labor force adjustment process, going on in the short run, to changes in technology. This is a dynamic process, intimately related to production. Neoclassical economic theory was not particularly well-suited to analyzing it. We therefore attempted to develop a new set of concepts, the internal labor market model, to provide the framework for viewing the process of adjustment to technological change taking place within industrial enterprises. It also appeared to us that this framework is applicable to problems of labor scarcity and a number of other current manpower problems.

The internal labor market is not new. It has existed for as long as production processes have been formally organized in any sense. But with the advent of larger industrial units, modern management practices, trade union influences, and the like, the internal labor market has become more formalized and more visible.

When we use the term "internal labor market," we are talking about an administrative unit within which labor is allocated by institutional rules. For purposes of today's discussion, the administrative unit is the manufacturing plant.

The internal labor market is based upon the distinction, made by employees and by employers, between the employment rights and opportunities accorded to those workers who are inside a plant or other administrative unit and those who are outside. The internal labor market is defined by a series of administrative rules and decisions which give it structure, and which define the interfaces between the jobs contained within a manufacturing plant and the external or conventional labor market of economic theory.

Examples of these administrative rules are found in promotion and seniority systems, which basically serve to allocate labor within many manufacturing plants. They define the sequence of jobs that workers move through as they are promoted, and also the on-the-job training sequences within the plant. There are hiring jobs or entry ports into these internal labor markets. These are the job classifications that employers list with the Employment Service and in help-wanted ads, or fill through informal recruitment. They are the points at which employers reach out into the labor market to bring workers into the plant. For both entry and internal job classifications there are various hiring and promotion criteria which are used to screen out or to select workers to fill job vacancies.

In manufacturing, the distinction between the ins and outs really amounts to a distinction between which job classifications are entry jobs and which are filled internally through promotions. In the industrial sector the range of types of internal labor market or promotion structures is wide. For example, in men's apparel and in many shoe and textile plants there is an open structure, so that practically every production job is a hiring classification. People are hired from the external labor market and put into jobs where they remain unless they are laid off; there is little or no movement inside the plant. On the other hand, in industries such as steel, petroleum, and chemicals, well-defined promotion sequences and tall promotion ladders are found; a worker is hired as a yard laborer or other unskilled worker and, through a series of promotions over a period of time, works up into the semiskilled, and often skilled, production and maintenance jobs in the plant. This type of internal labor market is largely insulated from the external labor market, because few jobs are filled by hiring.

Most common is a mixture of these two types. Employers in many industries will hire into low-skilled entry job classifications and promote into semiskilled production jobs. At the same time they will hire into the more skilled maintenance and industrial craft classifications.

This structure is important, in that it colors the way in which the employer views the labor market. It determines what kinds of skills he trains for himself, and what kinds of skills he relies upon some other training institution to produce. This could be the public educational system, MDTA or OEO programs, or other employers. Since the internal market structure determines, in part, where job training takes place, it also influences the kinds of qualifications, skills, and experience an employer seeks when recruiting labor.

A number of influences impinge upon the way the internal labor market is designed, and lead to the distinction between the internal and external labor markets. The first is the fact that there are a number of elements of job performance which relate to information about the way the plant operates: the layout of the plant, the skills of the job, the kinds of experience the job requires, and the like, are unique or specific to a particular plant. This is one reason why employers prefer to fill certain jobs internally. Related to this is the feasibility, and very often the necessity, of providing certain kinds of skills and experience inside a plant, on the job, by putting a worker on a machine and training him as he produces.

There are, therefore, certain economic incentives to employers to develop procedures to conserve the training which they provide, and to minimize additional training. They may attempt to reduce voluntary turnover by establishing formal lay-off procedures which give workers some certainty as to the order in which they will be laid off and of the kind of job security they have. This creates rights and expectations to job security, and often rights and expectations to promotion.

Similarly, judicious design of the internal labor market structure will permit employers to confine much of the remaining turnover to a limited number of entry jobs where the cost of turnover, in terms of training and recruiting, is normally lowest. Since workers, especially new entrants into the labor force, may not know a great deal about the employer or the type of work involved in a new job, much labor market activity consists of exploring the world of work. Employers, therefore, prefer to limit job shopping to those job classifications where the least training investment is required for job performance.

There is also an element of worker appraisal involved. Employers utilize screening procedures and hiring standards as proxies for underlying preferred worker characteristics. These proxies suffice for initial selection, while the probationary period provides a more reliable measure of employee ability. Again, economic incentives encourage the confinement of on-the-job screening to job classifications with the lowest training costs.

A second aspect of training which is responsible for structuring internal labor markets is that skills acquired on one job may provide a training base for skills required on other job classifications. This internal transferability of certain skills also permits an employer to build up a reservoir or pool of pretrained or partially trained workers who can be readily upgraded when employment expands.

Lastly, there are pressures for employment and income security generated by employees and their representatives which tend to encourage or to reinforce the external-internal labor market distinction.

It is our belief, basically, that the internal labor market and internal training, as I have outlined them, are an important, indeed a critical, element in many industries, in the process by which a rather generally trained labor force is adapted to the narrower, specific requirements of the job structure of the economy. Because many of these processes are informal, and therefore difficult to observe, we think they have been ignored, or at least underestimated, in labor market and manpower research and, as a result, to a large degree in manpower policy making. They are evident only in employee learning curves, worker productivity measures, and recruitment costs. The adjustments are often so informal, by their very nature, that employers are not aware that this kind of process is going on. To them, they are solving production problems, not adapting workers. In reality, they are doing both.

Our view of this process of adjustment is that employers implicitly develop manpower strategy. Thus, it is possible to identify certain forms of employer behavior towards the labor market as constituting instruments of private manpower policy. Examples of these instruments are changes in the job structure and the nature of the work performed in the plant, changes in the administrative rules governing promotion and training sequences, changes in formal training programs, changes in recruiting procedures, hiring standards and screening and testing methods, and changes in compensation. To these instruments, over which the employer has direct control, might be added modifications in out-plant training programs operated by other institutions, to the extent the employer is able to exert influence over the curriculum.

The employer can select from these instruments in a variety of ways. Some of the instruments are substitutes for one another to the extent that if you do one thing, you don't have to do another. Others are complementary. In short, there are a number of combinations of instruments available. In the interest of conserving time, and in light of a major policy interest of the Department of Labor, we would like to concentrate on one specific instrument—internal training. We want to emphasize again, however, that training is only one part of the whole adjustment process. All of the other instruments mentioned have to be considered along with training.

If we assume, for purposes of discussion, that the job structure of the plant is fixed, then there are often technical relationships among the jobs in the sense that natural training or skill development sequences emerge. Once these sequences are identified, an employer is faced with a "make or buy" decision when he wants to fill a job vacancy in the plant. He has to decide whether to train for it by filling the job from inside, or to hire a pretrained worker. The outcome of this "make or buy" decision is a function of (1) the kinds of skills required by the production function of the plant; (2) the nature of product market fluctations and shifts, and staffing requirements over the cycle; and (3) the nature of the skills and persons available in the outside labor market.

If union pressures, custom, and various costs associated with turnover are introduced into the system, then additional barriers are interposed between the internal and external markets, and the natural training sequences become reinforced.

Training is provided within the plant primarily for two reasons: (1) Necessity as dictated by the specificity of skills to a plant, and (2) efficiency.

I have already touched upon certain aspects of plant skill specificity, either real, in terms of the nature of work, or institutional, imposed by internal promotion policies generated by union activity or by employers' unilateral work rules. Where these kinds of specificity do not technically require in-plant training, there are often certain economies which internal training, especially that occurring on the job, provides.

The first of these is that a lot of training takes place by proximity to other jobs, or by working on related jobs. This sort of training is free—an obvious economy.

Second, a lot of training for semiskilled jobs takes only a short period of time—2, 3, or 4, weeks at most. Moreover, the number of trainees in a job classification at any one time is normally very small. It is, therefore, not economical to develop a formal training curriculum or to have a formal instructor and special training equipment.

Third, subtle changes that occur in the nature of equipment and products affect training. Workers and industrial engineers make minor adjustments in machinery, materials change, the nature of the final product's mix changes. On-the-job training is very often the only efficient way in which a training program can be kept current of all of these changes.

Fourth, there is the obvious economy of having a worker in an on-the-job training program and contributing to production as he learns.

Fifth, internal promotion tends to create a reservoir or inventory of skills inside the plant. This feature of the internal labor market contributes to the employer's ability to meet labor scarcities. The fact that an employer has, when he wants to expand employment, a certain number of pretrained or partially trained people inside the plant who can be up-graded, facilitates expansion of plant employment. Moreover, in a recession, the internal labor market can provide a place to stockpile trained employees while less skilled employees are laid off first.

The last efficiency of on-the-job training is that it is tailored to the individual's learning ability and to the narrow skills required by the job. A slow learner, by definition, gets more on-the-job training since the training program is geared to move along at the rate the worker learns. Moreover, a worker is trained in only those skills which are needed to perform a particular job.

In addition to having certain efficiencies, the internal labor market is flexible enough to permit adjustments, within limits, to dynamic changes in technology and in the external availability of skills. This flexibility occurs largely through the ability to stretch out learning curves as poorer quality people are hired, and by developing staffing patterns for new jobs which utilize skills already in the plant. Such flexibility is, of course, especially important in the case of the first generation of a new technology when it is impossible, by definition, to hire trained people.

When the need arises, internal training can also be formal. A rapid increase in employment or a radical change in technology may encourage formal programs. Sometimes these formal programs are only temporary, being designed to teach employees the jargon of a new technology and to orient them to a new machine. At a later date, as more of the new machines are placed in the plant, most employers talk in terms of substituting more informal training procedures for the formal program.

If the hiring te is increasing, either because employment is expanding or turnover is high, formal training programs may permit the capture of some of the economies of scale which are typically associated with such programs. Even in these cases, however, formal programs often become a duplication of on-the-job training procedures with production, in some plants, being routed through the "school." In at least one apparel plant surveyed, the trainee, with his sewing machine, was moved from the program to the plant floor, an example which dramatizes the importance of machine idiosyncrasies in the acquisition of skill and in worker performance rates.

Despite its advantages, internal training is not without constraints, nor is it entirely free. Internal training may run into problems, especially in tightening labor markets, because, by its very nature, it reduces productivity and diverts resources from production. A machine may be operated by a trainee at a time when the full production from that machine is needed, and supervisory effort may be diverted at a time when plant and equipment have to be pushed to the very utmost. These factors constrain the number of people who can be in training on the job at any particular period, and the rate at which a plant can absorb new trainees. Recently, some employers in expanding enterprises expressed the feeling that this constraint has become operative and that they are now slowing down their hiring because they cannot train people any faster. In such cases, there is a stretching out over time of the labor force adjustment that takes place.

The costs to the employer involved in the adjustment process therefore are reduced productivity, material wastage, machine down-time, and supervisory skills. There are also adjustment costs associated with recruitment and changes in screening procedures. One way an employer selects his manpower strategy from among these adjustment instruments is to appraise, informally, the costs involved.

I think at this point, I should stop and leave it to Michael Piore to tie together the loose ends of this discussion by telling you about the process by which an employer may develop his manpower policy.

MANAGEMENT REACTION TO CHANGED CONDITIONS

Michael J. Piore, Massachusetts Institute of Technology

DR. PIORE: My job is to pick up the pieces and direct them toward the problems of public policy. I would like to do this in terms of management's reaction to a tightening labor market and the absorption of disadvantaged groups. I do so partly because these seem to be the problems of most immediate policy concern; partly because the nature of the firm's adjustment to changed conditions can be seen more readily in terms of these problems than in terms of the problem of adjustment to technological change, which we focused upon in our report.

A tightening labor market means, to plant management, increasing difficulty in meeting its labor requirements; job applications tend to decline and turnover to rise. Management may react to these pressures through adjustments in any of the variables connecting the internal and external labor markets: screening; recruitment and training procedures; hiring standards; and, of course, compensation. Or management can sit tight—accepting higher turnover, working overtime, or, perhaps, curtailing production.

Some of these reactions are more conducive to the achievement of the Nation's economic goals than are others; some reactions are, in other words, more desirable than others. The basic strategy of public policy is to induce the plant to react in a socially desirable manner. Under most circumstances this means through reduced hiring standards and increased training. These reactions tend to relieve underlying labor scarcities. A reaction through increased wage rates, in contrast, will tend to set off a wage spiral in the community but does little to increase the total labor supply. In labor surplus areas, increased recruiting efforts may be desirable, but such efforts frequently lead to a situation where plants draw labor from each other, generating a turnover spiral in the community which, like a wage spiral, does little to relieve the underlying scarcity.

If plants are to be induced to rely more heavily upon reduced hiring standards and increased training, it is necessary to understand management's views of these two variables.

Let me begin by emphasizing the characteristics of the in-plant training encountered in our study. The important characteristics are threefold: (1) The training was highly informal, (2) it took place on the job, and (3) it took place in the process of production. Of these, the informality of the training process was most striking. Plants clearly are not reproducing the educational process that goes on within the schools. Even where the material taught is the same, the process through which it is taught is qualitatively different. But management typically does not know what that process is; they tend to describe it in such vague terms as "osmosis," "exposure," "hanging around" and "working your way up through promotion."

Formal material which could be connected with training was seldom used. Job descriptions, for example, were primarily instruments of wage administration and hiring policy, not training. Instruction manuals were rare, and, when they existed, actual training usually shortcut the manual procedures in one way or another.

Thus, to stylize the in-plant training process, it is the direct transmission of job skills, orally and by demonstration, from the incumbent (or experienced) worker to his inexperienced successor.

The training process frequently involves temporary substitutions in the process of production. The initial job is, in effect, broken into skilled and unskilled tasks. The trainee performs the unskilled tasks; the experienced worker supervises the trainee and does the more highly skilled components of the original job. As the trainee progresses, he is given increasingly highly skilled tasks; the experienced worker takes back some of the lesser skilled parts of the job. In the end, the original job has been reconstructed and the new worker fully trained. There is, in other words, a shortrun change in the character of the jobs which leads to a longrun change in the character of the labor force.

This is, as I said, a stylized view of the process; there are a number of variations. Frequently it is the foreman, rather than an experienced operator, who does the training. Vestibule training is fairly common. It amounts to little more than a separate production line for new workers, paced to their capabilities and closely supervised by experienced personnel. Some programs are formalized, in the sense that the trainee is moved through a prescheduled series of jobs. In all of these variations, however, the basic characteristics remain essentially unchanged. In formal training programs it is the sequence of job assignments, not the training process, which is formalized.

The nature of the training process has several implications for managerial decisions in a tightening labor market. First, as Professor Dunlop said—and I don't think you can overemphasize this point—training is, from management's point of view, a *byproduct of production.* On a theoretical level, it is true, training and production are joint products; they are produced together. But this is not the way management views the process. Management regulates production; training happens automatically.

This leads to a second point: Management finds it difficult to separate training costs from production costs, and does not usually do so. The costs of training appear as production costs; they are not separately identified. The cost of production is identified and training costs are diffused throughout various production indices: labor productivity, materials consumption, machine downtime, and the like.

This leads one to view with considerable skepticism programs designed to subsidize training or to insure employers against the risk of higher training costs associated with the employment of disadvantaged groups. Such programs attempt to provide a cost incentive for management to train when it does not view training explicitly as a cost item. In fact, the programs attempt to get management to change a procedure which it does not recognize as a procedure at all.

More fundamentally, we would like not only to induce plants to lower standards and engage in additional training, but also to make it efficient for them to do so. Actually we are asking the plant to develop new techniques for training people with whom it has not dealt before. We are trying to get plants to innovate, to speed up the training process, to reduce its costs, and to adapt training to new kinds of people, just as a manufacturer tries to speed up production, reduce its costs, and adapt its products to new uses. But we are looking for innovations in a process which we don't begin to understand as it currently operates.

I don't mean to overemphasize this point. Plants do, under some circumstances, recognize training explicitly, attempt to identify its costs, and look for innovations which will reduce costs. They do this when a new plant is opened and the direct transmission of skill between generations of workers is disrupted. They do so where major technological changes occur. And some plants which have been under continuous labor market pressure for a long time have done so. But these cases are unusual, and under normal circumstances the pressures required to induce plants to reexamine training may be intolerable.

Let me turn from training to hiring standards. The problem of inducing a firm to reduce its hiring standards is very similar. Most hiring standards are not really hiring standards at all, but screening procedures. They are designed to select from the applicants a group of people with a high probability of successful performance on the job. The selection is often done through the use of proxy variables; variables not functionally related to job performance, but which the plant knows from experience to be correlated with job performance. A high school diploma, for example, is frequently required not because of the material taught in school but because people who have completed 12 years of education generally show up on time for work and are not absent too often. In many cases, management does not even know this much about what makes a worker "good." When you ask a firm to reduce it hiring standards, therefore, you are asking it to enter unknown territory. And, in this area, management has great fear of the unknown.

The existence of the internal labor market tends to increase resistance to lowered hiring standards by imposing a barrier to experimentation. It does so, first, because once you get somebody into the plant, you cannot get him out. In union plants, disciplinary procedures confine the employer's right to discharge a new employee after a limited probationary period. In non-union plants, similar restrictions are imposed by custom; other workers get to know a man and, once they do, it is extremely disruptive to plant morale to fire him.

A second barrier to experimentation is "promotion from within." When you are hiring a man into a promotion ladder, and he will reach the top of that ladder in 10 or 15 years, you won't know the effect of reduced hiring standards until the end of that period. Small-scale experiments lasting 6 months to a year—however successful—are unlikely to induce a wholesale revision of hiring standards.

Resistance to lowered hiring standards has been further strengthened by World War II experience. That experience convinced economists that hiring standards can be reduced. And it certainly does show that, under extreme pressure, they will be. But the lesson which employers draw from the wartime experience is that such adjustments can be disastrous. They understand that lesson in very specific terms: they speak of it in terms of individuals whose work is completely unsatisfactory but who entered the plant in World War II and are still around.

I would like to add two or three general points about how to induce plants to absorb groups of workers they have previously barred. First, both in training and in reducing hiring standards you are trying to get plants to do something they have never done before. This is a process, first of discovery, of looking for new techniques; and, second of demonstration, of convincing management that the new techniques, once discovered, work. The second problem, that of demonstration, is, in many ways, as difficult as the first. To me, this remains one of the great mysteries. But I do think I can identify certain ideological barriers that must be overcome. One of these is the belief of almost every plant and company that it is different. If you come to a manager and say, "You ought to try this new training technique; such and such a plant used it very successfully; they like it a lot," the manager will tell you about his company's unique corporate philosophy. In developing and diffusing new techniques, it is important not to be taken in by the mystique of plant uniqueness. There is, of course, some truth in this mystique; but there are also general factors, common to all plants, and it is these general factors that we must look for and emphasize.

A second ideological barrier to diffusion is the belief that the only good things are the things which you pay for. This is one of the major barriers to the diffusion in private industry of techniques developed by Government under the Manpower Development and Training Act and the Office of Economic Opportunity. Because the Government developed these techniques, and they are free, they can't be worth much. I don't know how to overcome this.

I would like to end with a few words about the large company-small company dichotomy. We looked primarily at plants owned by large, multiplant concerns. There is a great danger in overgeneralizing from a sample of this kind. But there are, I think, certain aspects of small company policy for which our work may have relevance. There appears to be a kind of turnover syndrome in the low-wage sector of the economy. Plants in this sector hire people with poor work habits, people with a tendency to job hop either because they can't adjust to regular employment or because they pose discipline problems and are repeatedly discharged. But these poor work habits are reenforced by managerial policies. The low-wage sector is composed largely of small plants which are not well managed. The executives wear many hats. There is no personnel manager and little attention is paid to personnel policies. These plants have no orientation program for new workers and make no attempt to train their foremen.

Young men sometimes leave jobs, for example, when they get sick and miss a day's work only because they think that if they miss a day, they are automatically fired. It is possible for a man to work in a whole series of these low-wage plants and never be told about "calling in" when he is sick. The plants, on the other hand, ascribe their high turnover to the character of the labor force. The low-wage sector, in other words, is a sector in which it appears that the character of the plants reenforces the character of the labor force.

This is an important area for further research. It should be possible to reduce labor turnover significantly, increase labor productivity, and improve the work habits of the labor force simply by applying in small concerns the personnel techniques already known and utilized by large concerns.

On that note, I will turn the program back to the chairman.

DISCUSSION

Dr. Weber: The main concepts and ideas have been laid on the table, and I think we should proceed to a discussion of some of the implications. First, shall we address ourselves to the question of the adequacy or analytical validity of the concept of the internal labor market as it was developed in the report and restated in general terms here. Then, given the acceptance of the analytical and operational validity of this concept, I'd like to turn the discussion to policy implications.

Mr. Arnow: I have no question about the validity of the concept. I think the questions which arise are how to define and apply it, and how broadly it should be viewed.

The discussion has opened up some interesting new areas. From the point of view of public policy, I suppose it is fair to say that such policy is generally concerned with the market, whether it is aggregate policy or policy with respect to specific aspects. It assumes the operation of institutions and is concerned with how changes are effected at marginal points. I was glad to see, in this respect, that Mr. Piore takes the general internal labor market question and brings it down specifically to the marginal areas that are particularly concerned with public policy. At some future time we may be concerned with broader aspects, but certainly the main focus of attention is at the margins at this point.

Still, several questions arise. Looking at the internal labor market from the point of view of the employer and his instruments leaves open the public policy questions that are particularly related to workers at the margin. What happens to the people screened out through the various processes at work? What happens to those who are let in during periods of high employment? What happens to them as they progress through the plant, and what can be said about them in terms both of what we know and of what additional research efforts we can mount? Why are they now let out and to what extent should the standards applied to the screening processes be subject in some cases to reexamination in light of what we know? Work is going on in this area of supply. There are some very interesting things being done in the area of discrimination.

I was interested in the proposition that many of the training programs of the Government are, in effect, a substitute for screening devices—that their main purpose is not necessarily to train but to screen. The idea is that because a person has gone through a training program, although he might have been ruled out by an employer's test, he is now accepted as being appropriate for consideration. We might ask whether there are other areas to which we might apply the same rules. A person, for example, has not gone through high school and would fail a test, but he has served in the Armed Forces and been given an honorable discharge. Under what circumstances should he be regarded as having an equivalent of a high school diploma from the point of view of testing?

But several other ranges of problems that relate to what you might call the adjuncts of internal labor market policy come into the picture, particularly when we think of the problems of the disadvantaged and the fact that often and increasingly they, as a labor supply, are not located where the plants are. This raises problems that go beyond the areas of personnel policies, which are essentially the areas considered in the discussion. Is plant location policy, for example—with plants locating miles from available housing or transportation for the disadvantaged—a factor that must be considered from a different and broader point of view? Is this an area which Government policy should affect? In some respects, plant policy has been concerned with such things. It is a truism that a plant locating on the outskirts of the metropolitan area buys as much or more land for parking facilities as it does for the plant proper. Parking is given attention. Years ago, housing was given attention. Do housing and transportation have to come back into the realm of internal labor policies in an area of full employment?

A series of problems relate to points that Mr. Piore mentioned concerning the hiring of the disadvantaged. They were hired during World War II, of course, and in many cases, may have reached the top of the ladder, particularly in plants with plant-wide seniority. Being at the top of the seniority level automatically entitles men to certain positions that management may feel they are not ready for. What specific techniques of training or what special techniques of adaption can be applied as people come up the ladder? There is also the special problem of dual or discriminatory seniority ladders that exist where there are discriminatory actions against any minority group; and then there is the problem of pension plans that in fact discriminate against older workers and close possible ports of entry to them.

I have a few other questions relating to the report's conclusion that adjustment to technological change seems to be working out in a way which indicates that concern over such change in the recent past was exaggerated. I think it was exaggerated, but I think the conclusion boldly stated in the report is also exaggerated. It tends to minimize the problems of technological change that go beyond those which can be handled by an internal plant investment policy. Many problems of technological change affect not only the internal plant but the entire industry. These, in a way, are key problems—the process of technological change on the farm giving rise to movement of people to the larger cities, this in turn giving rise to the number of disadvantaged, and so on. This must be recognized, or the statement can be used out of context.

DR. FINE: I am an industrial psychologist and not an economist, and that is the way I have been listening here. In that context I find that much of what I have been studying, learning, and teaching in training programs for the past 25 years as a personnel psychologist is given a new name, the internal labor market. I am trying to understand what value this has. It probably has value, because one of our problems over the years has been trying to demonstrate to industry that training actually has a cost. We, of course, had a selfish motive. We used all kinds of selection and testing techniques and we wanted to prove that we were introducing something efficient which would reduce training costs. But we never made a very good case because we never had accurate figures. Now that the economist is concerned about the issue, we may be able to get cost figures and demonstrate the worth of industrial psychology practices.

As far as implications are concerned, it seems to me that we have been dealing with what you are talking about (without calling it internal labor market) for a long time. Back in 1939, in order to deal with the labor market, the *Dictionary of Occupational Titles* was published, with perhaps the naive assumption that workers could move freely in and out of every one of the more than 20,000 job categories listed. Very quickly we found that this was not so, and we had to develop an entry occupational classification system, along with the whole concept of entry occupational categories and requirements. In the process of doing so we became extremely conscious of the different entry problems for different areas of the labor market. Over the years these findings have been developed and systematized considerably and now they are built in as an integral part of the new occupational classification system. The second part of the code in the new system, for example, shows the movement of people from lower or entry levels of skills into higher levels. My point is that we have been pursuing the implications of your concept of the internal labor market for a quarter of a century, and have developed a better understanding of the fact that there isn't free movement in and out of all jobs but that there are very definite ports of entry.

DR. SOMERS: There are some key questions concerning the port of entry which must be answered if this concept is to be a valuable operational tool in analyzing the working of the labor market. For example, it is very important to know how long workers, newly hired, stay in port of entry jobs. It is quite possible that employers who hire these workers are really thinking not of the job they are hired into but of two, three, four or five jobs up ahead. If workers stay at the port of entry briefly, this makes a very different situation than that in which they stay there permanently.

I wonder if the authors picked up any data on the length of time workers stay in the ports of entry. If it's true that most employers do not expect the worker to stay there for any length of time, then the port of entry concept undergoes change, and factual data on this point would be useful in making the concept more operational.

The second point concerns the effect of full employment, as discussed in their study. The study was conducted in a loose labor market, and most of the questions we are talking about, most of the policy implications for training and so on, are germane to tight labor markets. It is almost a truism to say that training finally comes into its own when many job vacancies are to be filled. What happens to the ports of entry as the labor market tightens? Do the ports of entry increase very substantially, as I suspect they would when there are scarcities everywhere along the line, when the employer can move a worker from job "A" up to job "B" in the internal labor market only by creating a serious shortage at lower levels? I would think that if he could find workers with any skill in the external labor market to fill these open jobs, he would hire them when he has a labor situation as tight as it is now, let us say, in Milwaukee. Employers will hire workers from the external labor market for almost any job if they can find skilled men who come anywhere near the required qualifications.

There are also counter arguments. It may be that the actual hiring into ports of entry is reduced, and employers concentrate more on internal training when the external labor market gets tight. These two items then need more empirical work: the length of time workers stay at ports of entry, and the effect of a tightening labor market on ports of entry.

Dr. Weinstein: It strikes me that the firm's problem in manpower is analogous to the firm's inventory investment problem, only the capital stock here is human capital. Three possible external conditions affecting the demand for labor are decline, steady state, and growth, each with varying expectations. Thus, the firm can meet the changing, say increasing, demand by utilizing its capital more intensively through overtime, or by hiring workers at various points along the line. The options are numerous, and the concept of the entry point should not be fixed. As said repeatedly in the report, these points are not immutable.

As Dr. Somers said, an area very much in need of research is how these entry points will alter under various economic conditions. The model to determine the optimum sets of policies a firm might adopt to meet its needs may well be quite complex. Such variables as the state of the national economy, as well as relevant subeconomies or markets, would undoubtedly be significant. The entry strategy of a firm in a small community, where it may be the only source of employment for some skilled trades, will differ from that of a firm in a metropolitan labor market where it faces the alternatives of bidding away skilled workers from other employers, as well as training raw recruits. In meeting these needs, I see the firm as a mechanism more sensitive to cost than was apparent in the paper prepared for this session.

Dr. Wool: I found the report's theoretical formulation quite challenging even though, as has been mentioned, the substance of the institutional process described and the elements of this process have in fact been the subject of intensive study by separate disciplines—such as industrial psychology, industrial engineering, cost accounting, production engineering and personnel management. An important contribution is the fact that the economists are attempting to look at the internal personnel process as a system, as a model, and in turn, comparing this with the alternatives available for manpower development and training.

In the Department of Defense we have the largest internal labor market in the country, perhaps in the world. It has certain unique characteristics.

Dr. Dunlop: Certain ports of entry too.

Dr. Wool: The ports of entry are narrow. New entrants come in in two streams, with minor exceptions. They come in at the bottom of the enlisted ranks or the bottom of the officer ranks from two very different sources in the civilian population, and the whole process, subsequently—with some exception in recent times—has been one of internal progression. All terms used here, the strategies concerning recruiting, selection, advancement, career management, and training, are very much a part of this system, and clearly have costs and clearly have alternatives. We in the Department of Defense have a mass of internal data, with vast potential for analysis. We do have one major obstacle from the standpoint of economic analysis, and that is the production function, which is extremely difficult to measure. In other words, given the nature of the outputs involved, it is extremely difficult to measure the ultimate "pay-off" from different input strategies. Within this very serious limitation, the people who have studied this process have faced up to the need for a total model, particularly in terms of certain policies and programs which have received top administration attention.

For example, in our project called Project One Hundred Thousand, we are deliberately lowering mental and educational entrance standards and generating in this process a cycle of consequences for the entire personnel system. We are also establishing a huge data bank in which we are, literally, going to measure what happens to each individual accepted under these standards, as compared to control groups. If you take this one key decision, the change in selection standards, one has various possible criteria in attempting to measure the consequences for the "firm." From the standpoint of the unit commander or the line supervisor, who doesn't normally consider what it costs to develop and train his men, the concept of "optimization" is to get the best trained man he can for the job he has to do. For the military service as a whole, there are various other costs to be considered. For example, the more educated man, who is higher up the ladder in terms of training and adaptability, is also the least likely to stay with the military. You thus have a trade-off here of the cost of the greater turnover generated by higher standards, which has to be considered as part of the system.

Finally, and an equally important measure, from the standpoint of a government agency, is the possible fiscal cost to the Federal budget, narrowly derived, or the social cost to the economy as a whole of alternative selection policies. Viewed in terms of budget costs, the fact that the Federal Government has adopted responsibilities for manpower development and training means there are measurable costs involved in not training people in military service, and in training them under other programs. A relevant question is: Which is more effective in terms of attaining overall governmental objectives? You can even broaden this choice to social costs outside the narrow framework of the budget. I think that what we are trying to reach for here is a total model including all of these variables, an attempt on the part of top management, whether within a firm or within the Government, to get the full cost consequence of these alternatives in a broader sense.

Mr. McMillen: Was there any attempt made by the authors to analyze or take a look at the contributions being made by individuals trained by the Defense Department through vocational education or MDTA programs, or in private industry? How will the people already trained in an entry level occupational skill affect the port of entry, and what are the contributions they are making to the labor force? How many individuals now in the labor force have competencies acquired through public and private training activities and how do they affect the in-plant training problems discussed? When these individuals are employed, are their skills and abilities considered in terms of the immediate and long-range needs of business and industry, and what is the relationship of their competencies to the in-plant training programs?

Dr. Weber: It is appropriate now that Dr. Doeringer, Dr. Piore, and Dr. Dunlop comment on some of the remarks that have been made. However, before that let me summarize some of the points.

One is the point that the internal labor market is most significantly viewed within the framework of the total personnel system.

Two, there is some concern about the theoretical basis for cost calculations in deciding various policy alternatives and adjusting them in the internal market—particularly, social costs and the private cost.

Three, there were comments associated with better definitions of the concept of the "port of entry." What is it? How does it vary?

Four, there is some feeling that although we are talking about the internal labor market, we have to keep in mind certain relationships between the internal labor market and changes in *external* variables. One of the important research problems is to identify the relationships between the two.

Last was a comment that the theory as presented implies that all entrants into an internal labor market are equal; but in fact, each person comes to an internal labor market with a different stock of skills or potentials, which reflect prior training from various sources—MDTA, vocational education, learning at mother's knee, and so forth. Therefore, in assessing the nature and behavior of internal labor markets and the performance of individuals in these labor markets, account must be taken of these prior individual differences.

Well, with that, let us go ahead.

DR. DOERINGER: Let me address myself to two segments of the discussion. One is rather narrow and technical, relating to the ports of entry. I would expect that any attempt to identify and codify entry jobs in a manual such as the *Dictionary of Occupational Titles* would run into the problem that, once written down, they may change in response to certain predictable changes in the economic environment. That is, if you identify entry jobs—and you can't do it by just looking at skills—you must identify the jobs hired into for certain industries, or identify some classification in a large group of industries that have common types of entry ports. But this can, and perhaps does, change over the business cycle. Therefore, you may be talking about a different manual for each phase of the cycle. For that reason, I would be interested in hearing some more about how persons responsible for putting together such a manual take care of the dynamic aspects of the internal labor market.

In response to the more direct question of what happens to ports of entry over the cycle, we did not address ourselves to that question in this report because we did not have much of a cycle during the research period. More recently, however, we have been able to get some kind of a feel for this question and it doesn't appear that there is too much change, in terms of the formal structure, on the basis of a narrow sample. Small changes take place, mostly when an employer has the right to hire at different levels in the job structure, subject to the qualification that promotions be made from within if an employee is qualified. This whole notion of qualifications, or when you can hire and when you have to promote internally, may be sensitive to the cycle.

You can argue that, where there is much unemployment, offering a job vacancy to somebody who hasn't been in the plant and doesn't have any employment rights is going to be a tricky thing in terms of industrial relations. During the expansion phase of the cycle, if the limits of the internal training process are reached, a dual system of both internal promotion and the establishment of some new entry ports may emerge, with some "one-shot" vestibule training to provide the skills and experience normally developed through on-the-job upgrading. That does, in fact, occur to some extent for semiskilled jobs in situations where there is a very rapid expansion in employment. You also find in tight labor markets that employers who normally hire skilled workers from the outside market may have entry ports for electricians, machinists, painters, carpenters, and the like, but that they are inoperative because these skills are not available. Instead they may be trained for internally. In the auto industry, for example, they have institutionalized this process so that, to obtain tool and die men in tight labor markets, the hiring process is supplemented by a special upgrading program. My feeling is, therefore, that some very slight changes in entry ports occur, but probably only under great hiring strains.

DR. DUNLOP: That is right, but I think you stated the point a little sharply. If the ports of entry are so fluctuating that they change at random or change very greatly, then the idea isn't any good. The reality is that there is great stability in the ports of entry. The rates of flow through the ports may vary here and there and you may get some adjustments, but in general there is considerable stability.

There is a whole part of this research not reported on here, which has to do with the configuration of various types of internal labor markets. For instance, the market-wide apprenticeship committee is an internal labor market with a port of entry through the joint committee. A seasonal industry has very different patterns, and the internal labor market is analytically easy to explain. Why is it that in seasonal industry you have a great many ports of entry? Because with seasonal changes in employment, a cutter cannot all of a sudden become a seamstress, and a seamstress cannot transfer from machine to machine and preserve efficiency. You lay off employees into the external market, and you have entrances at all of these points in seasonal industry. On the other hand, in industries with very expensive capital equipment, there are typically long ladders of promotion to save costs as employees move up or down. You can examine various types of internal labor markets and explain why they have their particular configuration, and on the whole there is considerable stability in any one type. There is some adjustment, of course, as the external market tightens or loosens.

I agree that employers do not hire people with the immediate job alone in mind. Indeed, one of the most interesting industrial relations questions concerns whether an employer can refuse a promotion to a man who can meet job "C" on a promotion ladder but is unlikely to be able to meet the job requirements above that. That is a standard question under agreements and a question raised in arbitration. There are very different philosophies as to whether, to be promoted, an employee is to be judged in part upon the capacity to reach jobs above the immediate one in question. It is a crucial question in terms of the way internal labor markets work.

Now, regarding the discussion of the military—I quite agree with what Mr. Wool said. In fact, in a paper prepared for a New York conference in 1965, I developed the notion of the military as internal labor market. Professor Thomas Shelling and I have been working on this over the last semester. You can apply the concept to a university, a church; the rules relating to internal allocations of manpower are applicable to many situations. But if the ports of entry do not have a high degree of stability the concept is of little value.

MR. BIERMANN: What I am going to say is basically from experience in the Office of Federal Contract Compliance in dealing with minority groups. I don't intend to imply that our experience covers all the people that the Manpower Administration deals with. We have, however, come to two conclusions in seeking to find equal opportunities for minority groups. One is that certain institutions minority groups face are sometimes more "discriminating" than management. Seniority, for instance, may be based on job seniority or departmental senfority, and the minority employee may not have had an opportunity to get into that job or into that department. In such a case, the system becomes a discriminating institution. When you have dual lines of progression, with Negroes and Mexican Americans in one and whites in another, that, too, is a discriminatory institution. So, I don't think we should propose training programs for impoverished people but exclude from our concern these kinds of institutions as being untouchable.

Secondly, I don't think management is satisfied that it is getting the kind of people it wants through the screening process. We have found that institutions cause more trouble in getting minorities hired than any management we have ever had to deal with. Let me refer specifically to testing. I am sure you found in this study that management relies more than ever on the ability of the applicant to pass test requirements. And I will say—and use a conservative figure—that in 90 percent of the cases such tests have never been validated. There is no reason to believe any relationship exists between performance on the test and performance on the job. Usually the minority candidate fares in a much poorer manner in tests than the nonminority candidate. As a result, the minority candidate is not hired, or if he is in the work force, he is not promoted, because many times promotion is also based upon testing. So, the Office of Federal Contract

Compliance is in the process of issuing an order that requires Government contractors, before they continue to use tests which have resulted in disproportionate failure rates among minorities, to have those tests validated in a professional manner. The implementation of that order is going to take some time and we are not in the business of telling all American industry they have to stop testing. But we are saying that invalid tests should not impede minority employment and promotion.

Institutional organizations, in addition to the desire of management to adopt training programs, should also be a cause for discussion. I think, for instance, that a testing program is as much an impediment to a poor person as to a minority person. Our experience is that the port of entry itself, as an institution, should be cause for study and possible change.

MR. WILLIAMS: I would like to pursue Mr. Piore's statement that he doubted the validity of insurance schemes to get firms to hire disadvantaged workers. Let me start from the premise that most of the jobs we are talking about at the entry level are well within the competency of most of the disadvantaged people we would hope to reach in an insurance program as well as other antipoverty programs.

DR. DOERINGER: It depends upon how you define competency. Do you mean in terms of manual activity?

MR. WILLIAMS: I am talking about competency to do a first level blue-collar job. Here again, Mr. Somers' and Dr. Dunlop's comments as to the level of jobs at which people are being hired is relevant. Are people whose qualifications seem to indicate promotion several steps up the job ladder being hired? If you are going to plan to make the disadvantaged person more desirable, you have to know the hiring criteria, and what those criteria are meant to screen out.

The authors make a statement relevant to this problem of the criteria that seem to rule out many of the poor: "Firms imposed educational qualifications for employment because they believed that these qualifications would select a group of candidates who would perform well on the job. They knew surprisingly little, however, about the relationship between the formal educational curriculum and job performance. At best, the hiring standards were derived from crude and unusually intuitive or 'horseback' correlations between educational attainment and performance."

I would go one step further and say we know little about the relationship of demographic factors and job performance. So, in a sense, what we are talking about is not any hard and fast standard, provable in empirical terms. Rather, what seems most relevant is the employer's perception of the disadvantaged person. Then the key program question becomes, How do we do something that affects the perception of the employer in terms of these disadvantaged people?

Skipping back a minute to the point concerning the need for developing methods of risk reduction, since hiring disadvantaged people is perceived as high risk, some of the antipoverty and training programs aim at a form of risk reduction. For example, the skill component of work experience in the New Haven Community Action Agency NYC program was less important to employers than the evidence that the person was dependable. The New Haven Community Action Agency had built a reputation in the community for giving good information concerning the individual participant's work habits. In a sense, the organization was a risk reduction factor.

In any insurance scheme the key question is, What are we insuring against? What is it that employers fear? Certainly it is not the lack of skill on the first job. This seems clear from the Doeringer-Piore report. I think what bothers employers is whether the disadvantaged will fit in, and whether they can progress up a job ladder.

Let me close by saying it is pretty obvious that the immediate delivery point, in the port of entry, is not too important. People meet these skill levels; that is clear. What are the other things that confront us beyond this first skill?

DR. WEBER: Thank you. Let me just say that both the report and the discussion are replete with generalizations concerning employer behavior. I think the time is ripe to call on management people to see if the academic approach, whether in Government or universities, accurately describes the behavior and perception of management. So, if I may, I would like to call upon Mr. Smith from Western Electric and Mr. Fryer of Xerox.

MR. SMITH: I find that based on forty years experience, the conceptual papers presented here this morning are a reasonably accurate description of what actually goes on in a large manufacturing concern.

I agree that the testing process is not an evaluation of the potential skill generally required for port of entry into blue-collar jobs. It is a screening process which, combined with the interviewing process, is designed to weed out the dull, the not alert, those not judged to be competent, under simple instructions, to learn and perform satisfactorily. Business does not have precise cost figures on some of its operations. It has historical data developed for reference purpose, but I defy anybody to set up, for example, a precise cost of the introduction of a new product into a production line. A new product has to be conceived; it has to be engineered; it has to be debugged, and all of these have in them elements of cost. I agree with Mr. Dunlop that industry views these as costs of production even though it doesn't know precisely what the costs might be. I think the concept is sound and the description of the internal labor market accurate. The port of entry theory depicts what goes on externally in large industry. Certainly in our industry, 90 percent of our hiring in the blue-collar area is at our first two levels of skill. Of course, in the professional areas, we look for other things. I think the papers we heard present a sound concept.

DR. FRYER: The experiences we have been having in Xerox—and I was amused at the point that most companies think they are unique—are spreading very rapidly and are of concern for companies trying to grow very quickly. This kind of growth condition within a company, let alone within a labor market, has a very definite impact on internal movement, and all of the adjustments that are possible. I think perhaps this group is a bit too harsh on the testing institutions. If you look at institutions in terms of discriminating, you can go much beyond testing. Testing makes a lovely target and those of us in the profession have our own problems to live with.

What is happening in industry is, perhaps, not as pure as one would expect. We should be searching for criteria to convince management of the demonstration value of concepts. I suggest that, in fact, the incidences which convince management are not necessarily economic models but tend to be day-by-day significant values. For example, we deliberately put together a program for upgrading the skills of disadvantaged people to meet the higher rather than the lower standards. We had quite a few sceptics within the company as to whether this would work, even though we were using the best orientation training. One turn of events swung them. A blizzard forced us to shut down and the word went out that the plant was closing. Five of our 16 trainees didn't get the word. They dug their way out of the blizzard and arrived at the plant ready to go to work. Nobody else was there. Next day there was a perceptable change in attitude on the part of the managers, the foreman, as to the attitude of those trainees. I grant you this doesn't have the empirical beauty we strive for, but it does have value.

MR. PIORE: Perhaps the most significant contribution to policy would be to list the things that hit management and get a point across to them. Our research is not going to do much good if we don't get it across to management.

I want to go back to a question which is implicit in the points raised by the preceding speakers. Why are there internal labor markets in the first place? I think it is true that the structure of the internal labor market does not readily respond to economic conditions, that ports of entry and promotion districts remain relatively stable. Two factors are important in producing this stability. One of these is institutions; we left that out of the whole discussion. The point was raised by the gentleman from the Office of Federal Contract Compliance, but we didn't get into it there.

The structure of the internal labor market is institutionalized. Institutions can and do reflect economic forces. But institutions cannot change rapidly; they change only gradually over time. The process of institutional change is critical to the whole adjustment problem. We need to know a great deal more about this process and how policy can speed it up.

I do believe that a tight labor market, if sustained, will eventually effect changes in the structure of the internal labor market. The fact that you have different internal structures in seasonal and relatively stable industries, that plained by differences in the economic environment, suggests that economic forces do affect the structure. But it takes time. The tight labor market is of relatively recent origin. The interesting question, it seems to me, is not whether the institution will change, but how long it will take for it to do so.

There is an alternative to waiting for institutions to respond to economic pressures: Institutions can be changed through legislation. But it is also important to recognize that institutions have to function. Seniority, for example, is not an accident. It is designed to achieve certain social values that we have thought important. When we evaluate seniority, we are weighing the social values of the past against the new social value of integration. I don't know how you balance these two things.

Let me add, just to round out the picture, that it is not only institutional rigidities that have made for the stability of the internal labor market; an economic calculus is also involved. One of the things holding up change now is the belief that the tight labor market will be of short duration. The Vietnamese war may be particularly important here. Although we might have reached the present market without the war, most people believe that the war is the primary causal factor, and hence believe the market will last no longer than the war does. They are not going to make fundamental changes in their equipment and procedures—changes including heavy investment—for a market that may loosen at any moment. If we had had a tight labor market during the whole postwar period, the decision made in World War II wouldn't seem in retrospect to have been a mistake. Many of those decisions would still make economic sense.

DR. DOERINGER: Employers do tend to respond. You begin to discover employers facing the tighter labor market situation and reacting to signals of internal labor market problems. Signals do not usually appear on the cost accounting sheet, but they may become visible in other ways. Employers do tend to be sensitive to things such as high turnover. In a defense company, for example, there may be a job that keeps tossing out defects which are related to turnover. As the labor market tightens, these and other signals begin to appear and employers detect them and try to formulate solutions. Thus the employer begins to deal with signals that reach him; not cost signals, but turnover, hiring difficulties, and quality problems.

Most employers have procedures for interacting with the labor market. These are typically developed through dealing with a fairly loose labor market situation. The initial reaction to tightening labor markets is to do things the old way. This may mean a more expensive recruitment effort to deal with an immediate production problem. Through a process of searching and experimentation, the employer often finds, as turnover and hiring difficulties continue, the old way of solving a manpower problem doesn't work. Production foremen complain that they have job vacancies or that the training process is inefficient.

In the process of search, each employer has to solve a particular set of operating problems. Employers are sensitive to shortrun problems. Only when they begin to think that their shortrun problems are recurrent will they be directed to more longrun solutions.

Right now we are still in the stage where employers are searching for adjustment techniques. Some are innovations—in training, in supervision, in dealing with turnover problems. And they are beginning to think in a more sophisticated manner about labor problems, including recruitment, testing, how to go about finding new sources of people to bring into the plant, including active recruiting among minority groups. All this is occurring in response to the discipline of the tightening labor market.

One implication of this search activity is that the Labor Department can discover new methods of adjustment, or perhaps generate experiments in labor market adjustment which can be adopted more generally. A host of experiments are being run now, some by the Government and some by private groups. They need to be publicized more actively to short cut individual trial and error.

Mr. Chavrid: I get the impression from the papers of Dr. Piore and Dr. Doeringer that employers respond quickly to the job market conditions and develop programs to resolve their manpower shortages through, presumably, training, promotion, and reductions in hiring specifications. I find it difficult to reconcile this observation with the trend in job vacancies information. According to estimates made by Garth Mangum and Sar Levitan,[2] there were over 1 million job vacancies in the United States in the spring of 1966. Based on other information, such as unfilled job openings at the end of the month in the public employment offices, this figure of 1 million is probably twice the size it was 2 years ago and may well be three times the size it was some 5 years ago when unemployment rates were much higher than at the present time. It would seem to me that if employers planned ahead, we would not have a substantial number of job vacancies at the present time, especially when we have some 4,000,000 unemployed. I would like to know if the authors found whether or not the employers from whom they obtained information did plan their training programs ahead for some period of time, so as to assure that they would have an adequate supply of trained manpower within their plants.

Dr. Piore: In all frankness, I think that when we wrote the report we were more optimistic about adjustments taking place automatically than we are today. At least, I feel that way. The labor market was looser at the time we did the research upon which the report is based, and that biased both our sample and our thinking. We tried to correct for the bias but we were not completely successful.

Now, one of the problems is that we don't know what a job vacancy means. That is true in the following sense—and this relates to Dr. Somers' point about whether, as the labor market tightens, employers do more internal training or less. In a tight labor market, some employers do more internal training. Under these circumstances, what does a vacancy mean? There is a job which is normally filled from outside. If a qualified man came to the gate, he would be hired. In that sense, the job is vacant, and, if asked about it, a vacancy would be reported by the employer. But that does not mean that the job is sitting idle. That job is covered, typically through some kind of arrangement that involves training. But the arrangement often means more employees doing the work—and, in fact, more unskilled employees—than if the skilled worker were available. Those skilled workers who are available supervise several unskilled trainees. In effect, the job is split up during the training process and unskilled are substituted for unavailable skilled workers. This may be part of the answer to the point you are raising about job vacancies.

Dr. Dunlop: If you look at job vacancy statistics in Rochester that come out of the Labor Department or the National Industrial Conference Board, you will find a great many are job vacancies outside of production and maintenance jobs in manufacturing. They are professional jobs: teaching jobs, jobs in hospitals, and others outside the manufacturing sector.

In the early stages of our research, we got together with the NICB people, 15 or so major firms in the United States engaged in manpower planning. We asked them to share their methods on the technical side. I found it very interesting. A great deal of work has been done in professional and technical areas, but a more limited number of firms are doing manpower projection work for production and maintenance jobs. My objective would be to have every large-scale enterprise in the United States engaged in such work.

Dr. Doeringer: First of all, talking about an increase in vacancies in blue-collar manufacturing jobs, you would expect that, even if an adjustment process were taking place, a vacancy in a skilled position—a skilled maintenance mechanic or a skilled machinst, for example—would initially be listed as such. If an employer has never given training for skilled jobs, he has to get in the frame of mind to do this. When he finds that he cannot hire outside, he then must find an alternative, such as training. A skilled job vacancy should disappear, over time, as the training and upgrading adjustments are being made, without anybody *hired* into the skilled job. The only way I have of validating this is by asking an employer what his job vacancies are. Usually they say: "I would like to hire such and such." You then ask what they mean by a job vacancy and it turns out that the job is being done in spite of the vacancy, but in a slightly different way. The concept of the vacancy is very tricky. It is registered at a point in time, but to understand the adjustment process, it should be traced over time.

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[2] "Coming to Grips with Unemployment," *The Reporter*, November 17, 1966, pp. 44–64.

In answer to the comments on manpower management, we hope to look at some of the major corporations in the country to see what kinds of differences there are between manpower planning in a loose and in a tight labor market. I have found recently two bits of evidence that make me suspect that manpower planning is becoming more common in a tight labor market. Firstly, employers seem to have done planning in the past for those occupations in "scarce supply" and with long training times, such as scientific and professional occupations. Secondly, a number of employers mentioned that they were surprised by the tightening labor market and were beginning to do some planning, in a very broad kind of way, for blue-collar skills in order to increase the lead time of reaction to labor scarcities.

Dr. Weber: I must say the trend of discussion here is interesting. Two alternate formulations have been presented. One, training solves all problems, so no planning and vacancies are present, and two, there are vacancies and management isn't paying enough attention to training. They are inconsistent, or at least superficially conflicting.

Dr. Doeringer: In the "longrun" world, of course, training works out all right without planning. I think the question is, Can planning and more attention to the adjustment process that takes place in a natural fashion enable the adjustment to take less time?

Dr. Weber: But in terms of efficiency, I understand one of the focal points is to provide wider opportunities for people presently looking for jobs. In fact, as Mr. Chavrid indicated, he has a problem to get disadvantaged or minority persons hired, especially in view of the barriers presented by testing.

Mr. Chavrid: Referring to my first observation about job vacancies and the need for training programs, I agree with the comments made by the authors that the existence of job vacancies in any one plant may not necessarily hinder production schedules. The employer may increase his hours of work from the "standard" 40 to a 46-hour week, but give his "vacancies" figures on the basis of 40. The increase in the hours of work often results in greater labor costs. The employer, it would seem, would much prefer to have a "standard" week where no premium pay for overtime would be necessary.

Mr. Myers: I should like to say two things about job vacancies. First of all, hiring standards are not fixed or rigid. If an employer interviews someone he likes, he will often make the adjustments necessary to fit him into his organization. The hiring standards given by the employer for a specific job vacancy are usually minimal. The person hired may be better qualified, with respect to experience or education, and may receive higher pay than the stated, minimum rate. Thus detailed job vacancy information may be misleading as to the range of opportunities available and may also be a poor indicator of the ports of entry.

The second point is on the statement that when a firm has job vacancies, it has neglected to forecast and prepare for its manpower needs. We have two pieces of evidence readily available on the difficulty of forcasting manpower requirements. The first is the comments in the Doeringer-Piore report on the inability of employers to forecast the future manpower needs associated with specific technological changes. The second is from the conference on manpower planning at the company level, referred to by Dr. Dunlop, where employers reported that the best they can do is to forecast the number of persons they will need, with no breakdown on occupations or qualifications.

Mr. Cheston: I thought the major conclusion of the study, the one that interested me most, was the efficiency and reliability of plants' adjustment to technological change. I sense a backing off from this. Mr. Piore said he was not as optimistic now as he had been. I think that deserves more comment.

Dr. Piore: If I am going to answer that question, I must go into the whole thought process that led up to what appears on paper. This is a very difficult kind of research—at least it was for us. We were trained in pure economic theory. Professor Dunlop managed to qualify our theoretical training somewhat. But we didn't fully appreciate the qualifications. That is, we had already learned them once, but they were not driven home until we went into the plants.

Given that kind of background, we didn't expect to find the kinds of adjustments in the plants that we did find. And, at first, what impressed us most, and what we concentrated on, were the kinds of adjustments taking place. An additional factor, as I said, was that we were initially looking at technological change, and technological change is something that firms expect to adjust to.

So, to be quite frank, it was not until we turned from the problem of adjustments to technological change to that of adjustments to a tightening labor market, that we began to see limitations upon the process of adjustment. We realized that it wasn't a question of adjustment or rigidity, but rather a question of the speed with which adjustment took place; that there were the alternatives of curtailing output, accepting turnover, recruiting in Canada. And we realized that the automatic reaction to a tight labor market need not be the absorption of disadvantaged groups.

Dr. Dunlop: That is a different problem. There are limits to the capacity of an internal labor market to absorb large quantities of the disadvantaged, particularly in short periods of time.

Dr. Doeringer: I think the basic tools of the adjustment process can be applied to disadvantaged groups. Integrating such groups into the job structure of the economy poses a new kind of problem which management must learn to cope with. In a period of transition to full employment, there are problems of adjustment which do not occur during full employment. How well the adjustment process works may be a function of the rate of progress through the transition period.

Dr. Zeisel: I didn't read every page of the report, but the point appears to be made that a sort of internal institutional structure dominates and maintains the ports of entry at fairly low levels in the skill scale. It occurs to me that the level of the port of entry is a function also of both the demand for and supply of labor. The rigidity of the ports of entry reflects the fact that the company's demand for labor is usually not so tremendous as to force a change in the pattern of hiring. On the other hand, when the pressure of demand becomes intense, the labor market usually has tightened up so substantially that there is no supply of skilled workers and virtually no entry of blue-collar workers above the lowest levels. So, you have a kind of built-in rigidity in both loose and tight labor markets. But, what about a situation where demand for manpower is considerable in a loose labor market, for example in a firm that is growng extremely rapidly such as Xerox. I suggest in that case that ports of entry would become flexible and exist up and down the skill scale. If trained manpower is made available—for example, through training—and prosperity is maintained, limited ports of entry would not offer a problem to the employment of these workers.

Mr. Arnow: Let's look at the concept of the internal labor market and the external labor market and relate the job vacancy question to it. It is at the ports of entry that the external meets the internal, and while I agree that the ports of entry tend to be stable, it is important from a public policy point of view to know the ways in which they move with respect to the circumstances and kinds of industry that are subject to variations. For example, we have basically, I suppose, two groups of workers who loom large in our social problem: the young people and the old. For the young people the port of entry is a lesser problem, in a sense, than for the old. I think we need to know the margins and possibilities for change.

Dr. Somers: We must make a distinction, in a tightening labor market, between whether the port of entry is open or closed, and how much traffic goes through it. In discussing job vacancies and the lengths to which the employer is willing to go to fill them before resorting to the outside labor market, we must recall that even though steps may be taken as temporary adjustments, they are not necessarily satisfactory. One would expect that most ports of entry are potentially open in a tight labor market, but that very few people are coming through them; and this is most significant from the standpoint of policy toward disadvantaged people. The fact that ports of entry are open in a tight labor market provides the opportunity for getting disadvantaged workers into those openings if they can be given proper training and motivation.

MR. SMITH: The port of entry in our industry is very stable. In the blue-collar field, if you exclude the industrial craft and electrical technicians, we hire 95 percent of our people, at the first two grade levels, and there is a constant churn at the plant where I am located. We manufacture over 10,000 equipment products and over 75,000 component products, and there is never a time when we don't have job vacancies at some point, or people for whom there are no jobs at another point. And, although data show that our employment levels at the beginning and the end of the year are constant, still, during that year, every other person in the plant has been moved once, on the average.

I would like to make one further declaration. It is my belief that manufacturers will do as little or as much training as they need to produce their product and sell it on a competitive market—no more or no less.

DR. WEBER: Thank you. We will now adjourn the morning session.

AFTERNOON SESSION

DR. ALLER: Only a few minutes ago we got word from Dr. Duesenberry that he was called to the White House. Therefore, Gerald Somers from the University of Wisconsin has very agreeably said that he would serve as a substitute chairman for the afternoon session.

DR. SOMERS: Thank you. The focus for the afternoon session is on policy. There is no more important issue in the whole field of manpower policy than the interrelationship between the public and private spheres. A discussion of this issue has emerged in almost every manpower conference I have attended in the last year or so. The question inevitably arises as to the proper role of public authorities in the field of vocational education and training, and the appropriate place of the private sector. Some are willing to ascribe almost no role to the public sector in the field of vocational education and manpower retraining. They are willing to accept general public education on one hand and private on-the-job training on the other, and see nothing in between. Of course, many others place a very strong emphasis on the public's role in vocational training.

Our first speaker, Garth Mangum, will discuss the role of public manpower training programs. Dr. Mangum is Research Professor of Economics at the George Washington University and is directing an evaluation of Federal programs

PUBLIC PARTICIPATION IN TRAINING

Garth Mangum, National Manpower Policy Task Force

DR. MANGUM: My most impressive qualification was missed. I am the only retrained coal miner in this town, and there is no other evidence that it can be successfully done. I think that is somewhat relevant to the subject because I was asked to discuss the four comments on the last page of the report summary in which the authors set forth what they consider to be the justifications for public participation in private industrial training: (1) When the broad skills of computation and communication are provided; (2) when the cost of training has inflationary implications; (3) when the training provides an experimental and demonstration function: and (4) when results of the experience are exchanged among private parties.

These points raise some important questions about the justification for public intervention in this whole training and internal labor market process. There are broader justifications for public intervention, though narrower than the tendencies have been at the Federal level in the last few years. The basic principle is that a social benefit, in excess of private benefit and at least equal to the social cost, must accrue. Basic education contributes to economic development by producing a skilled labor force. For that purpose, most of us would allow a somewhat broader role than simply the teaching of reading, writing, and arithmetic.

The second point, that of underwriting inflationary training costs, I find hard to understand. Under what circumstances should the cost of training be picked up by the public sector in order to prevent inflationary pressures? Why would training be less costly if paid for by the public? However, this point does get at an important justification for public intervention in the training area: a situation in which the employer's reluctance to hire the available labor force might be inflationary. The employer has several alternatives: (1) He can employ the unemployed at whatever cost that might impose, train them if necessary, or put up with their relatively low productivity if that happens to be the problem; (2) he can compete with other employers for those who are already employed; (3) he can use his present labor source for longer hours, and more intensively; or (4) he can simply not meet the demands of his customers. Any of the four may have inflationary implications. I think there is a justification for public intervention at that point in either one or two ways: either trying to make the available labor force more attractive by remedying its deficiencies, or subsidizing the use of that less attractive labor force sufficiently to make it attractive to employers.

That relates very closely to a third function which was the focus of much of the discussion this morning, though not mentioned in the paper. This is the central concern of public manpower programs in recent years, the problem of getting the "left-outs"—those members of the labor force who are competitively disadvantaged—into the system. Our major manpower efforts fit into these categoriesr We try either to make the idle members of the labor force sufficiently attractive that the employer will take them, or subsidize his employment of them through some semantic subterfuge.

Each of these approaches is reflected in training programs, the first in institutional training and the second in on-the-job training which is getting increasing attention and is no longer solely a function of MDTA. Under recent legislation, the Neighborhood Youth Corps can also do on-the-job training. The Economic Opportunity Act's Title V program for welfare recipients has always had the legal authority to use on-the-job training and has been criticized recently for its failure to do so. The new Special Impact program could, within its broad authority, provide on-the-job training. In light of this report, which focused primarily on on-the-job training and these legislative developments, a discussion of the relative advantages of institutional and on-the-job training should be useful. How do they fit together? When is public intervention justified either in doing the training, or paying the employer to do it, and how might these methods be coupled?

The institutional route can be justified, just as can general education, by saying that education has social benefits over and above the private benefits. The institutional programs provide basic education, prevocational training, and skill training which may be much broader than that which an employer would provide for his own needs. The training is intended to make an individual attractive to many employers, rather than to some particular one. It is conceivable that you might pay an employer to do this broader training, but it is not being done. We are subsidizing on-the-job training by providing what is ostensibly reimbursement of the cost of training, but from the employer's standpoint it is probably no different than a wage subsidy. He is looking at the labor cost of a particular kind of employee. In effect, the Government says: "We will pay you $25 a week on the average which we will call a payment to cover the cost of training. But, whatever it is called, the purpose is to make this group of people more attractive to you."

To make the point clear, the only way one can justify public underwriting of the costs of on-the-job training, when that training is no broader than the training that the employer needs for his own particular purpose, is to get an employer to hire people he would not otherwise be interested in. It is to redistribute existing jobs in favor of those who face various disadvantages. To that extent, institutional and on-the-job training are trying to serve the same purpose, and the issue is which is the most effective, the most efficient way of accomplishing that purpose?

I have been playing with numbers in this area the last few days. I don't have all of the information that I would like to have, but I have a few preliminary notions. MDTA, in the earlier years, was criticized for taking the cream from the available unemployed. This policy was not surprising, under the circumstances. For one thing, there was a lot of cream in the unemployed. In 1962 and 1963, many experienced people were unemployed. As the labor market has tightened, there has been an attempt to dig more deeply into the disadvantaged groups. Congress has been critical a number of times in the intervening years of the failure to use on-the-job training to the extent they thought desirable. Therefore, there has also been an attempt to shift more of the burden to on-the-job training. As a result, at the beginning of fiscal 1967, the decision was made to have 65 percent of the training go to the disadvantaged and 35 percent to the solving of labor shortages; at the same time on-the-job training was to be increased from a very low proportion to half of the program. The two decisions work against each other. Institutional training has been digging more deeply into the disadvantaged groups, but on-the-job training has moved in the opposite direction.

OJT brings in relatively few of the undereducated, the older and younger, the inexperienced, and the minority groups. Therefore, at first blush it would look as if one should concentrate on institutional training. But that is an oversimplification because on-the-job training has some very clear advantages. It is cheaper, and once in on-the-job training, there is a high probability of continued employment. By adding these two factors, OJT appears potentially, but not currently, more efficient in bringing the disadvantaged into employment. For instance a Negro has half the chance of getting any available on-the-job training "slot" as he has of getting an institutional one. But once in training, he has about two-thirds more chance of getting placed in a permanent job as a result of OJT than of institutional training. Since OJT costs only a fourth of what institutional training costs, you could well argue that on-the-job training is twice as effective a route, if it were not for another consideration. An unknown but apparently quite high percentage of the people who are filling these on-the-job training slots are current employees—so-called "preferred nominees" selected by the employer, ostensibly because the man was going to be upgraded, opening a place underneath him that would bring in the disadvantaged. There has been no administrative device for assuring that would happen. If half of the OJT trainees were preferred nominees—and it might go that high—there is not a great deal of difference between the effectiveness of institutional and on-the-job training as a method of placing the disadvantaged.

However, which route is the most likely to get a man into a job is one problem; which is most likely to give him the best long term career is quite another. Do you give the man the most promotability and the best long term career by taking him into institutional training, where you can give him some adult basic education and broader skill training, and then into a job, or by taking him the OJT route, where apparently he would get nothing more than just what was needed for that particular job at the entry level? The only way one will ever answer that question is by following some of these people a few years. Unfortunately, so far as I know, there is nothing really underway to accomplish that.

I will summarize by saying that the only way to justify public involvement in training people for the internal labor market, and particularly for that which is precisely within some particular firm's job structure, is to use it to bring the disadvantaged into successful competition for jobs in the mainstream of employment. If we can't do that, we ought not to be in the business, and we ought to be trying to evaluate all of these programs on that particular ability or lack of ability.

Dr. Somers: Thank you very much. This excellent presentation raises another important issue to discuss later this afternoon. To what extent should the pubic involvement in manpower training be only for the disadvantaged? Vocational education people spend much of their time on nondisadvantaged groups, and I am sure Mr. McMillen will want to say something about this later. To continue the discussion about the relationship between the private adjustment process and public training programs, our next speaker is Dr. Forrest Fryer of the Xerox Corporation, whom we met this morning.

MANAGEMENT AND MANPOWER PLANNING

Forrest W. Fryer, Xerox Corporation

Dr. Fryer brings a good combination of academic and management background to bear on this topic. He received his doctorate at the University of Maryland in Psychology. He held the position of Manpower Management Administrator when he first joined the Xerox Corporation in May of 1963 and in that position was responsible for setting up, evaluating, and maintaining the manpower planning functions of the corporation. He is now Manager of the corporation's Personnel Research Sub-section.

DR. FRYER: Thank you. I was interested, Dr. Dunlop, in your comment concerning how much better shape we are in, apparently, on managerial manpower planning than planning on blue-collar manufacturing jobs; especially since many persons at a conference on managerial manpower planning which I chaired last week felt we were in pretty poor shape on the managerial side.

First, I would like to say that, as a practitioner in industry, I am extremely pleased with the review of the Nation's internal labor market by the Harvard group. Although I am not an economist, I feel this kind of model is conceptionally the framework necessary for effective planning of manpower within the private sector. The key to effective manpower planning is the personnel system. For too many years, personnel functions and activities have been taken at face value by some managements and rejected by others. There has not been enough attempt in the personnel area to recognize that most managements look upon support overhead functions, such as personnel, from the viewpoint of their contibution to profits in production and, in some managements, how they may contribute in society. Part of the difficulty, however, in management's view of manpower planning is that for years it has been emphasizing only those factors internal to the company. These are the most convenient and possible to control or influence. For years many firms have shown little concern for replenishing the labor supply. They simply dip in and take what they need. This has brought about some of the comments this morning as to need for compliance controls, and certainly it emphasizes the need for public support. On the other hand, I think, just as industry can perhaps be indicted, so can Government in the sense that it seems to have emphasized the external factors in the labor market such as total labor supply. Management simply does not have the context within which to use effectively such data and, thus, often they are ignored.

I was asked to discuss briefly the four objectives outlined in the research report. It goes without saying that my comments are going to reflect the bias of my training and my 8 short years in an industrial environment. I think the key to the report is the point made as to whether the Federal Government is to become more heavily committed to subsidizing adjustment. I think the question appropriately is, To what extent can the Federal Government afford *not* to get involved in and committed to subsidizing some kinds of adjustment. You have all heard the old argument that industry is able to take care of itself, and certainly experience shows that some industries have operated on that assumption. I say that, in recent years, corporate responsibility to social problems and more enlightened management are more prevalent themes in American industry, and this should be fostered, nurtured, and encouraged. There is a real problem, however, in translating this corporate enlightenment down to the managerial foreman level, which is where the action is.

Concerning the first objective, that of providing general training outside the plant in basic math and verbal skills: It is hard to speak against training, whether inside or out. I think one of the difficulties in the training programs, no matter how they are subsidized, no matter who supports them, is that training can fall into some of the same traps as testing, as mentioned this morning. Training is often accepted at face value, especially in a dynamic situation. We need validation of training programs just as we need validation of testing programs. For example, our recent in-plant program in Xerox, to teach math and reading skills needed to meet the regular standards for industrial employment, is meeting with interest from other companies. Also at this broad level are action programs, such as Rochester Jobs Incorporated, which is certainly arousing the interest of many employers in the Rochester area. This is a recently announced arrangement formed by 40 companies which have agreed to hire 1,500 hard-core unemployed. It is this kind of program which really in part supports objective number one.

Concerning subsidies for training, to help prevent the need for price increases by the plants—I hang up, quite frankly, on measurement of training cost. A considerable amount of training is taken at face value, and the quantified payoff seldom, to my knowledge, links directly to price determination. What we really need is a measurement of training cost and evaluation of its impact, and then perhaps we can relate it to price.

The third objective is the best area for both the private and public involvement. This concerns subsidizing experimental training, screening and recruitment programs as an incentive to developing new in-plant adjustment techniques. It is too easy for routine personnel activity to become an uncoordinated, competing sequence. Furthermore, the adjustment process can be one of misunderstanding, misconception, and shortsightedness. The most classic case in my experience was a situation several years ago where a personnel department and line manager were protesting vigorously that the scores required for some incoming employees for port of entry jobs were entirely too high. Yet when we took a look at the situation we found that the test scores were eliminating only 20 percent of the people who were not hired and the other 80 percent (except for a few on physical examinations) were being eliminated in the interview.

This morning, looking at the institutions surrounding ports of entry or personnel actions, we put the spotlight on testing, but other institutions, such as screening, also need a much closer look. In this process, all the biases operating in managers and other individuals will come into play.

Objective four, communication among plants about adjustment techniques, is a logical outgrowth of knowing more about those techniques and, of course, it is important. It is the only way in which we will gain maximum value from earlier efforts. Conferences such as this do this to a certain extent, but I am disappointed that only two industries are represented in this meeting.

In overview, it appears that the private sector has had a limited view of manpower, and is only beginning to recognize and act on its responsibility in the area of replenishing and upgrading the labor supply. In all good faith, I would like to take a slightly different point of view from my counterpart, Western Electric's Paul Smith, in this morning's session.

I shudder to think that a typical American firm would do no more or less than was demanded of it, and it is important to note that management is now increasingly saying that some activities within industry will not be judged only on a value return basis. And the extent to which they are doing that is significant.

DR. SOMERS: Thank you very much, Dr. Fryer. I share your concern that only two industry men are here. I certainly wish more were with us today.

Our next speaker, to carry on this discussion with emphasis on the public role in aiding the disadvantaged, is Judah Drob, Chief of the Division of Program Utilization of the Office of Special Manpower Programs, Manpower Administration. One of his principal functions is to see what we can learn from demonstration projects carried on under MDTA.

UTILIZATION OF RESEARCH AND EXPERIMENTAL RESULTS

Judah Drob, Manpower Administration

MR. DROB: Thank you. I want to illustrate the approach necessary if we are to get utilization out of the kinds of insights, the kinds of knowledge, that this sort of study produces. For that purpose

I am going to ask a few questions, and suggest some answers. You have many more answers than I have; my suggested answers are going to be illustrative only.

The first question we have to ask is, What else that is relevant is being done? This particular piece of work doesn't take place in a vacuum. We want to know what kind of floor of knowledge is under us. I would like to mention a few things and I am sure you will have many others that are important as parts of our floor of knowledge. There is a Manpower Administration research program called "Gatekeeper" which is relevant. It is a primary investigation into the ways in which the people who determine who will be hired exercise their prejudices in selecting people. Dr. Fryer's comments about the interview, of course, are very relevant here. The man who developed "Gatekeeper" has some elaborate ideas—for reeducation of the gatekeepers. He has interesting ideas on the use of closed-circuit TV for this kind of reeducation.

We are involved in JOBS NOW, an approach which goes on the assumption that a significant number of employers can be persuaded to take on hard-core unemployed, meeting, with some help from outside, whatever difficulties come with trying to absorb such people into their regular work forces.

Mr. Smith of Western Electric is here because he is involved in another very interesting activity, which certainly deserves attention. It is called the Business and Industrial Coordinating Council of Newark. Here a large number of employers are accepting responsibility for training disadvantaged people for jobs in shops other than their own. This activity in which his corporation is engaged refutes the generalization that he made earlier today.

These activities I am describing are all funded under the Manpower Development and Training Act. Another activity is Skill-Advancement in New York. It is helping small employers upgrade their low-skilled employees. And, it is the intention of this particular experimental and demonstration project to leave behind a cadre of trainers in each of these small outfits who can carry on the upgrading activity. This relates very much to Dr. Piore's remarks about problems of the small concern.

The Jewish Educational and Vocational Service of Philadelphia is refining a work-sample technique which we hope will be a good substitute for the kind of pencil and paper tests that we find are so discriminatory right now. We are helping foster, in a good many communities, a kind of self-help activity in which minority groups are organizing themselves to prepare members of their own group for employment. These activities include, first of all, Opportunity Industrialization Centers on the Philadelphia model, established first by the Reverend Leon Sullivan, and in the southwest a program called SER which is composed of Spanish-speaking men and women. There are many others.

I want to mention a few other activities which are federally funded but not necessarily funded under the MDTA. We have an expansion of the notion of work experience from the Neighborhood Youth Corps to encompass adults as well, through the Nelson and Scheuer amendments to the Economic Opportunity Act. This is being administered by the Bureau of Work-Training Programs in the Department of Labor. We have Human Resources Development, a major program of the United States Employment Service, under which we hope State employment services will pay individual attention to as many of the hard-core unemployed as they can reach. We have the Concentrated Employment Program, again a Department of Labor activity. Then, in the new Department of Housing and Urban Development, we have the Model Cities Program and Neighborhood Multiservice Centers. These and other aspects of the same kind of activity all look toward what we have been considering here—delivering a work-ready person to the entry port. We have been talking about two aspects of this problem, a demand and a supply side. And the supply side has to do with delivering a work-ready person. As Mr. Chavrid pointed out, the chances are that any work-ready people we can deliver will be employed. So, the problems in this area are very important.

The next question I would like to raise is, What are the target audiences for this kind of knowledge, and how can they be involved in absorbing the new knowledge developed? How do you get anybody involved in doing something? That obviously is a major problem and one that we certainly can't claim to have solved. One of the techniques that is important, and Dr. Fryer pointed out how important it is, is consultation. If we don't have industry representatives here, we can't hope to have much influence on them. Consultation recognizes that the one you are consulting with has knowledge; he has problems that must be taken into account when you try to apply the new knowledge. He can help refine the new knowledge and, in so doing, he can develop a stake in using the refined product. That currently is our thought about useful means of getting people involved in using new knowledge.

The Business and Industrial Coordinating Council and others in Newark have discovered to their chagrin that there is another way to get people to use new knowledge, and that is with pressure. As Mr. Smith could testify, this has, at least in that case, resulted in a careful reexamination of what his corporation had been doing. I think the response of BICC is a very important one.

Another method of getting people involved is participation of the poor, which is stimulated by the Economic Opportunity Act.

Still another device—a very useful one, we think—is the use of indigenous people in the various services provided to help people prepare for employment. I think that the use of indigenous aides can go way beyond the pubic sector. Many corporations could find useful places for what we call the indigenous aide. I hope sometime they will have a chance to look into that.

How do you speed institutional change particularly? How do you get policy executed by people at the lower levels? This is a problem both in government and in industry. Mr. Smith could testify to the fact that the problem can be licked, and that it is possible to get lower level people to carry out policy. It takes surveillance by top management. It requires rewards for performance. It requires training. It sometimes requires a significant incident such as Dr. Fryer described. But let's not assume it is automatic, because we know you can have institutional dinosaurs as well as biological ones. Public school systems, for example, present the possibility of becoming institutional dinosaurs.

Another question is, How do you get people to use available tools? Dr. Mangum described what is available under MDTA. There is much more. MDTA has been amended several times, most recently just last year. The new sections of MDTA could be used and could help solve some of the problems we have been talking about.

One of our chief problems is how to get industry to accept on-the-job training, and we certainly haven't licked that yet. Now, what we get down to is a very serious question: How do you produce work-ready people out of the disadvantaged population? I don't think it is easy, and I don't think you can toss off the answer as training or anything like that. It is time to challenge the conventional wisdom and to start looking seriously at whether the kinds of training and counseling that we do currently are really any help. Some experimentation, demonstration, and research suggest that much of what we do in many of our projects is counter-productive. And this suggests to me that we had better have a open mind on the subject of how to produce the work-ready person to present at that entry port.

One of the ways we will continue to get the kind of knowledge we need, and get it into use, is by further experimentation, demonstration, and research. We are hoping that in the next year, for example, we will be able to put a fair amount of our effort into increasing employer involvement in training and preparation of people for work. We need ideas from all of you as to the kinds of things that we could be trying in this experimentation and demonstration area. But my final question: What else needs to be done? We agree, and our authors agree, that they haven't given us the last word on the subject.

Let me repeat the questions that I raised. Probably there are others. What else that is relevant is being done? What are the target audiences? How can they be involved in absorbing new ideas? And what else needs to be done?

Dr. Somers: Thank you. You have not only raised very serious questions but you have helped to provide the answers. One of the difficulties in Mr. Drob's answering the questions he raised, is that this is what Dr. Dunlop was supposed to do next. As a matter of fact, the mimeographed program seems to have anticipated just the right questions for him to talk about: Responsibility of private and public sectors for easing skill shortages; utilization of the hard-core unemployed, and adjustment to technological change. These are certainly the issues that have emerged from this morning's discussion and again from this afternoon's.

FOLLOWING UP ON THE INTERNAL LABOR MARKET

John T. Dunlop, Harvard University

DR. DUNLOP: I am a strong believer in the importance of the interrelationships, between analytical ideas, empirical work—including statistical work—and policy consideration. And I was interested in the area of the internal labor market because the analytical concepts we have developed facilitate empirical work and policy discussion. Like all tools, they have limits, but the bringing together of integrating ideas and experience, is one of the principal reasons some of us stay in universities.

I should like to list, if I may, a few areas of further work that seem important, that grow out of the concepts of the internal labor market.

The first problem concerns probationary periods. Why are they typically 30 or 60 days in most agreements? In one experiment that I know of, in dealing with the hiring of disadvantaged groups, the union and the management changed the customary 60 days to 9 months. I thought this a very interesting idea. It is clear that marginal groups from the labor force point of view often involve considerable risk to an employer. One way to increase opportunities for their employment in the internal labor market is to increase the period of time before the final decision on their permanent attachment to the firm is made. The logic of the probation periods, their duration and so forth, is an area that could stand more work.

Second, we have identified today the importance of the small-plant problem. We need much more information on the extent of training feasible in the small enterprise, on an industry basis or a locality basis as distinct from an enterprise basis. For the large enterprise, which was the subject of this particular study, I think we have learned some things. There are sectors of the economy, types of labor markets, and sizes of plants that may require training on either a community or an industry basis. Other countries have experimented with such arrangements, and we need a good deal more work here.

Third, the method of manpower projection on an enterprise basis for various occupations and categories of manpower is another area I would stress.

Fourth, I have been experimenting with a concept which I feel is important to further work in the manpower area; I have called the idea the "breadth of training." I don't think we know very much about this area. How broadly trained should an employee be? The view of the employer may be quite different from that of the worker. The view of the worker at one point of time may be quite different from his view on a career basis, and the breadth of training for entry may be quite different from the training a person ought to have to progress up promotion ladders. I think it is possible to quantify this idea of the breadth of training. Breadth of training is related to vulnerability to technological displacement. It is related to adaptability and versatility. It is related very much to career choice, and there are real needs to explore this concept. In a sense, internal seniority systems and promotion ladders constitute methods of training which influence the breadth of training. It is important to analyze the views of the unions and employers on how broadly trained people should be.

A fifth area would be to develop some classification of internal markets and to use the analysis on a series of different markets. We have talked about the military, university, and nonprofit institutions. The longshore market and the market in many branches of construction are different types of internal labor markets from those in manufacturing, and a comparative view of these types of markets has analytical value.

Sixth, I would also be interested in a study of the differences in internal movement patterns of workers, and the rules governing them in the same industry and in the same size plants, between union and nonunion establishments. I feel the differences between large-scale union and nonunion plants are much less today than they were 25 or 30 years ago. While this may not be of much interest to people who are concerned purely with manpower problems, those of us who are interested in industrial relations find that manpower and industrial relations questions are not entirely isolated.

A seventh area that would interest me has been identified in terms of entry jobs. Which ones are they? How stable are they? I have indicated my views about that. Is there some way of redesigning them? This is a part of the whole problem of redesigning seniority districts in a number of plants to accommodate technological change, to accommodate to the need for greater mobility over geographical areas, and greater opportunities for disadvantaged people. Entry jobs, and what can be done with them is a matter of great significance.

The suggestion that is explicit in this report about the transfer and study of techniques and training is obviously also an area which requires a good deal more work.

Another thing we might do is to reflect on what we know about the experience of countries of Western Europe, where you have had prolonged periods of high employment. One thing I would be interested in speculating about is the extent to which the job broker will become more important in our society. As high employment and perhaps even overfull employment become characteristic of many jobs, we may see the growth of labor brokers whose job is to pick up disadvantaged and other people and to provide relatively stable employment for them by serving a number of different employers. This sort of thing is growing in some of the Western European areas, and a look at this problem in our own situation would be useful.

These are some of the principal areas of work that I think would be a start in following up on the internal labor market.

DISCUSSION

Dr. Somers: Thank you very much. You have raised important areas for further research.

This is a good place to begin general discussion on various questions.

Mr. Smith: I would like to say that perhaps Dr. Fryer and I are not as far apart as my original generalization led him to believe we might be. When I said that industry will do the training that it needs to do, no more and no less, I was referring to industry hiring people who are below the entrance level on qualification—paying them a salary and training them or providing skills within the plant—for whom they could not see a reasonable short term need. I would agree completely that it is an appropriate use of corporate funds for any business to be a good corporate citizen in the community and to further the work to which Mr. Drob referred. About 15 or 20 businesses have dedicated some $300,000 on the basis of matching State and Federal funds on general projects in Newark to train underprivileged people. This project is getting off to a very successful start. It will be some time before we can get a qualitative evaluation of our product in the actual work situation.

I must comment on Dr. Mangum's observations that the underprivileged people cannot get jobs, and that industry should provide jobs for them. I suspect each of us around this table has a job. It is logical for us to assume that everybody wants a job and is willing to work. But this simply isn't so. And, I don't know what has to be done to motivate people in areas where it is so urgently needed. If people want to work, will behave, and will perform satisfactorily in a job, they can be trained to work.

The program now underway in Newark has been in operation for 3 months and our experience to date is that 25 percent of the people who sign up for the training program never show up at the training quarters. Those who enter the program are judged by the people who recommend them to be qualified to absorb the training; neighborhood youth organizations, the Urban League, the State Employment Service, churches, all have recommended candidates for this training. Once they enter the program, 25 percent decide that they are not interested in the mechanical trades, but still want to learn a trade, and they are spun off into other programs such as gardening, shoe repair work, and the like. Twenty-five percent can't accept the training discipline of the program. And we actually are turning out only 25 percent of the original group that applied for entrance into the program. Of the 25 percent who have graduated, over 90 percent have been placed in jobs at rates of pay from $1.90 to $3.25 an hour. We don't know how they are performing in the jobs. We hope to find out through followup. The point I am trying to make is that there is an opportunity for hundreds of people to get a meaningful skill in an area where there is an urgent employment need, and jobs are waiting, but we get only 25 percent of the initial trainees to stay with the program.

Dr. Mangum: I can only say I am not surprised. The numbers are not atypical.

Mr. Smith: We as citizens and taxpayers are getting short-changed in our investment in the public school system today. The schools do a pretty good job with the college-bound youth. They rate themselves on their ability to get those who want to go to college into college. They pay little attention to the employment-bound youth. Business, industry, and Government can make a significant contribution in getting the school system to do a better job in this area.

Dr. Aller: I am happy to announce that Dr. James Duesenberry, of the Council of Economic Advisers, has come in and will now speak to us. Dr. Duesenberry.

Dr. Duesenberry: Thank you. I am sorry to have been late but I am glad to get in on the discussion. I hope you will help if I find myself lacking in information on what went on before. I have been asked to say something about the Council's views on trade-offs between employment and price levels, and how manpower programs fit into that. This is a familiar subject and I won't take much time.

As you know, there is a lot of history behind a discussion of the interrelation between fiscal and monetary efforts to change demand and entry rate employment on one hand, and manpower programs to fit qualified people for employment programs to fit qualified people for employment on the other hand; there was some controversy on the subject a while back. I think, as it turned out, we got considerable distance with the main emphasis on the aggregate finance side with assistance from manpower policy, up until last year. It was the Council's view last year, and it still is, that we have about reached the end of the rope as far as the prospect of reducing employment by just creating more demand with no further assistance from the manpower side. It is our feeling that the labor market last year suggested that further reductions in unemployment with the present characteristics of the labor market would be accompanied by very substantial labor shortages and inflationary pressures. These, we think, are politically unacceptable and would be counterproductive in terms of our longrun employment-production goals.

Our current view is that further reductions in unemployment are contingent on improvements in our labor market structure—mainly, through manpower training efforts, but also through other changes in the labor market structure, particularly improvement in the effectiveness of the public Employment Service—with the understanding, of course, that these have to be accompanied by appropriate expansion of demand. One can't just train people, and generate the demand required to create the jobs for those trained. These things have to keep pace. There are different views as to how fast we can hope to reduce unemployment through this route. But I think there is fairly general agreement that we have to put heavy emphasis on manpower training and other reorganization of the labor market, if we hope to get unemployment significantly below its present level while keeping tolerable levels of price change. That is our view of how these two things fit together. I think, by now, there is some agreement on that, although within the Government there is not always agreement on the prescription for any particular moment's policy. I leave it at that and open up the discussion on the report.

Dr. Doeringer: What you are talking about, and what we talked about this morning, was really that much of the adjustment in the structure of demand for, and supply of, labor takes place in the plant in response to pressures to get the work out. Without getting into the whole controversy over what causes unemployment, what recent evidence has the Council been discovering to indicate that we are at the point where we must seriously consider that adjustments within the private sector will cease to be adequate as the unemployment rate drops below 3.7 percent? I suppose the policy question really is, Which of the manpower institutions that provide such adjustment in our society are going to have to bear the brunt if we reduce the unemployment rate in the future?

Dr. Duesenberry: Well, let me give just one piece of an answer through the insertion of a point I left out. It is wrong to think about tension in the labor market as being neatly measured by the level of unemployment. Much of the labor force change we generated last year did not merely reflect the fact that we got unemployment down below 4 percent. A very large number of jobs were also created, and there was then a strain on the capacity of industry to adapt itself to those circumstances and train already employed people for higher grade jobs and then take in new people. In some ways a remarkable job was done, but there were some places where the process needed more time than we had, so a labor shortage developed. That means that we would presumably have considerably less labor shortage if we stayed at 3.6 or 3.7 percent unemployment than occurred in the year when we got to that figure from the 4.7 rate. We went down just about 1 percent in a 12-month period. And in the course of that, a large number of people were brought into the labor force off of farms. While most of them got work, we were left with substantial shortages.

Our view is that we had much too much labor shortage last year. Wage pressures arose, quite outside the negotiated area, and if employment expansion settles down to a slower rate which only about keeps pace with the growth of the labor force, much of the tension will evaporate and there will be less wage pressure than there was. That will get us back to the kind of price stability that we need, but it doesn't leave anything to spare. So we don't think demand can be created at a much faster rate than the rate of increase in the labor force.

The other thing is that the remaining unemployment consists of two big segments. One is true frictional unemployment, associated with entry and reentry into the labor force, voluntary quits, and so on. This adds up to a great part of the total number of weeks lost. There is not much you can do about this. The Employment Service can whittle it down some, but, in any case, this is not a great social problem. If a man is out of work for 3 or 4 weeks, he is not a big social problem.

Now, the other part—the special problems. There are problems of special areas that are also difficult to deal with in the aggregate, and then finally there are the people who have got all kinds of personal troubles, who are not oriented with the job market, who lack skills and education and are just not employable. When you create a million jobs, you create a spectrum of jobs. You can adjust by training some people already employed for higher grade jobs, and by introducing new people at the bottom. But there is a limit as to how much you can do that. The unemployment is disproportionate among people who need training and education. It isn't going to work out methodically that you can make adjustments to bring them into steady jobs very fast. So we need work on that group, although I think we also need work in stepping up internal promotion—for instance, training illiterates who have steady but unskilled jobs, who therefore are blocked from promotion and have to have help so they can move up and other people can take their places at the bottom. That is only one example. But, I do think we need emphasis on training programs in order to make this adjustment of skills to the demands of the labor force, both inside and outside the plant.

Dr. Wool: One of the areas for internal labor market analysis noted by Dr. Dunlop is the military. Along the lines of what Dr. Duesenberry has mentioned, it's a lot easier for the military than for most employers to lower standards at a time when they are expanding and hiring a million new men a year. Under these conditions, they can set up a fairly ambitious target of taking a hundred thousand men in qualitative categories which they hadn't tapped previously. This would amount to only 10 percent of their total input. However, in a more normal period, when their hiring rate is 500,000 men a year, this number would represent 20 percent of the input. Just as in the rest of the economy, they would then be in a looser labor market. When the military commandant knows that better people are available, he is going to try to get the best men he can. This, of course, again gives you a problem of balance between social costs and the costs to the individual employer or supervisor, as he sees them.

Secondly, the problem of choosing between on-the-job training and more formal training has many interesting analogies in the military. In a sense, one can say that all military training is a form of on-the-job training because it is geared to some specific occupational requirement. However, because of the scale of the operation, if nothing else, you really have within the military very massive formal training programs of a vocational type. The cost of formal occupational training for enlisted men alone is about a billion dollars a year. This, of course, does involve a good deal of scrutiny and determination of the situations where on-the-job training—that is, taking men after basic training and putting them directly into a unit—is preferable to formal school training. In the military, as in the case of any individual civilian employer, on-the-job training is not separately budgeted, and its costs and relative efficiency are elusive. Even though we can conceptualize this cost, actual measurement has not been made. We thus have a close analogy here with the situation of any private employer. There are some interesting observations about the institution as it works which I think could help provide a great deal of insight to alternative management strategies. On the other hand the unit commander, the user of trained manpower, would prefer to get the training establishment geared to his specific job requirements as closely as possible. This reduces his own supervisory problems. From the standpoint of the service as a whole, you have a dilemma because of the problem of massive mobility, within the establishment itself, generated by rotation, career management, and turnover. The military thus finds it desirable to train men in somewhat broader job categories. This involves more of the academic vocational type of training and imposes somewhat more of a burden of training upon the unit than when the school graduate comes in and only has to become familiar with specific equipment and specific routines. Over the years there has been a continuing clash of interest which can be observed ever since massive formal training programs began in World War II.

One of the more obvious considerations, though, is the length of expected service and the probability of the individual staying with you for a sufficiently long period of time. If you have a force in which a large percentage of men are going to be for 2 years, 3 years, or 4 years and they have only one or two assignments, the logical strategy would be rather specific training for a specific job or two. If your objective is a career force and you are gearing both your standards and your training to upward mobility over a 20-year career, the strategy becomes very different.

Mr. Henle: I found very provocative the statistics that were furnished dealing with the tentative results of the Newark Project. What Dr. Somers was saying is that those results are probably typical of that kind of situation. Now, as I recall, the first quarter consisted of people who did not show up even for the initial training, the second was a group which fell by the wayside because they could not take disciplinary training, and the third group became interested in other than mechanical training.

Mr. Smith: The third group found during the training that they were not fitted for work in this field and they spun off into other programs.

Mr. Henle: In terms of dexterity?

Mr. Smith: Their motivation, their desire and flair for machines, and a lot of factors.

Mr. Henle: And finally there was the fourth group which did accept the training, graduated, and at this point appear to be successfully placed.

Mr. Smith: Ninety percent of them.

Mr. Henle: The first point to make is that for the third group, the training they received at Newark might well have been valuable in terms of their later development, even though they did not prove adaptable for one reason or another to mechanical types of training. The individuals may have acquired certain work habits and a certain interest in a job that might prove useful later on. At some point in time, somebody should find out what happened to this particular 25 percent. However, let us look at the remaining 50 percent where, seemingly, a well-organized program developed to attract people, with full community support including the best recruitment techniques, did not succeed. In this connection, let me suggest that we shouldn't necessarily insist that everyone work. Sometimes in discussions of training programs, the underlying assumption seems to be that work is automatically the best or only activity that people should engage in. However, not everyone may agree. We are very proud of the affluent society we have developed, but this affluence also means that certain people can get along one way or another without working. They can scrounge off friends, relatives and neighbors, or they can obtain income through illicit or other means. At any rate, they may find that their best way of adapting to the present society is to not work rather than to work. I see no reason in cases of this sort for society to insist that these people work. I do say that the opportunity has to remain open to them at all times.

Finally, in many of these cases, particularly where young people are involved, it may well be that, over the course of years, attitudes will change. It is important that the way be kept open, but I suggest that we don't have to consider training a failure if not everyone decides that he likes training and wants a job.

Mr. Smith: I think the point to make in this connection is that this 50 percent—if this is what it turns out to be—who do not want to work are part of the 3.7 unemployment rate about which we are so concerned. If we have an unemployment rate of 3.7 percent, and 50 percent of those counted among the unemployed don't want jobs, we do not have the tragic unemployment situation we think we have.

Mr. Henle: I go along with you part way on that However, I don't think it is at all certain that these individuals are among those who, in answer to a household inquiry, would indicate that they have been actively looking for work during the last 4 weeks. This is our unemployment test. I think many of this group would be classified as "not in the labor force"—a small but growing proportion of adult men who are not counted as either employed or unemployed.

Dr. Piore: I am very concerned about the high turnover group, the people who don't seem to want to work. We hear comments about this group wherever we go. And it is not just employers who talk about it. People who are interested in manpower problems from the workers' side talk about it, civil rights workers talk about it. Thus, it appears that there is something more to the comments than a prejudice on the part of employers against disadvantaged workers.

To some extent it is a problem, not of "wanting to work," but of basic habits which enable people to work; many people are not accustomed to steady work and cannot stay on the job. Ideally, we would like to teach people work habits; but we don't know how these habits are acquired. When we talk about literacy, we know how literacy is acquired; we know the kind of process that goes on. But we really know nothing about what is involved in "wanting to work." This is an area in which we need a great deal more research.

It is possible that this group of people who "do not want to work" are a component of frictional unemployment. It appears that many of these people do work; but they keep changing jobs, moving in and out of the labor force, and they are picked up in the figures. They may be responsible for a considerable portion of what we call frictional unemployment. Hence, if we could solve their problem—which is really a structural unemployment problem—we might reduce frictional unemployment as well.

Dr. Duesenberry: We do have some numbers that make it look as though there is not as large a population as many people think that isn't showing up as participating. We have some estimates of the undercount, and I don't think you can arrive at a conclusion that there is any very large number of people who don't want to work most of the time. There may be 500,000, but it isn't an enormous number.

Dr. Piore: Perhaps this isn't an undercount problem. Perhaps these people actually are in the labor force.

What I basically question is the definition of "wanting to work," of being in the labor force or out of it. The thing is, these people do work. They go out, look for a job, take it, and then quit. If you ask them why they quit, they say, "The foreman was nasty," or "I didn't get along with the other workers." But if you talk to the foreman—sometimes even if you just question the man for a while—these explanations don't hold up. In other words, the man has a specific reason for quitting and he may even believe it, but it does not square with the facts of the situation.

Dr. Somers: I wonder if we can do more to relate this afternoon's session on the disadvantaged worker to the discussion this morning on the internal labor market. I think Dr. Mangum has put his finger on the dilemma of the time. We know the advantages of on-the-job training. Discussion of the benefits of internal adjustment within the plant indicates that on-the-job training has many advantages from the standpoint of cost, likelihood of employment, and future security on the job. And yet we know that if we want more disadvantaged people trained, on-the-job training doesn't seem to be the way to do it. Employers are not eager to take on disadvantaged Negroes. The discussion this morning leaves a rather pessimistic implication that if employers can adjust fairly nicely to their needs, they may never reach that desperate point in which they hire large numbers of disadvantaged people for on-the-job training. This might be induced by a subsidy, but there is the further pessimistic note raised this morning that a subsidy may not do any good.

I would like further discussion on this question, because I feel that one of the great needs of the day is some imaginative formula for a subsidy to employers to encourage them to accept disadvantaged workers for on-the-job training.

Dr. Weber: I drew exactly the opposite conclusion from this morning's discussion. Dr. Piore and Dr. Doeringer have clearly demonstrated the strength of on-the-job training, and have shown that on-the-job training is a viable part of the employer's strategy. Therefore, when the demand for labor increases and the supply of experienced workers is highly inelastic, employers will invest in on-the-job training. So it seems that we should be optimistic concerning management's ability to absorb marginal workers. However, we may be pessimistic concerning the generation of sufficient incentives to give employers momentum to use this capability.

Dr. Somers: I think we are not so much in conflict. My point is that because their adjustment process seems to be so successful, they may never be pushed to that desperate stage at which they will finally take on disadvantaged Negroes. When they can get new entrants to the labor force, the hardcore remain unemployed.

Dr. Weber: I might answer that there is no evidence in this study about management attempting to differentiate systematically among labor market conditions. We don't know what the marginal rates of turnover are. In Chicago it is clear, given the fact that unemployment is down to 2.3, that changes in institutions and attitudes toward certain segments of the work force are taking place. Employers are picking up disadvantaged groups. In Chicago I think unemployment among Negroes was something like 4.5 percent.

Dr. Somers: For Negro teenagers?

Dr. Weber: Not for teenagers but for all Negroes. Companies like General Electric, for example have hired Negroes for the first time. Motorola is now demonstrating actively that they have never discriminated. What I am saying is that we really haven't let the forces of full employment operate.

Dr. Duesenberry: I can see people sitting around in Turin saying that the Calabrian won't or can't do productive work. But, given the fact that they have the opportunity to go to Germany or Switzerland to find jobs, such marginal groups have been pulled into the labor force and have found jobs.

Dr. Somers: Talking about Chicago, what about the recent findings that Negro teenage unemployment has reached 25 to 30 or 40 percent in large cities even though we are down below 4 percent in national unemployment? It seems to indicate that employers don't see the need to hire Negroes and don't respond to encouragement to accept disadvantaged workers. And if it is true, as was said this morning, that employers don't know and don't calculate their cost of training, a subsidy isn't going to make much difference. I think this is a very pessimistic finding in regard to absorption of the hard-core unemployed.

Mr. Drob: Employers don't take the subsidy now available under on-the-job training.

Dr. Duesenberry: I think there is something we ought to say about the subsidy under OJT. The pressure on the people who are administering OJT is to fill OJT slots, not particularly to fill on-the-job training slots with a particular kind of person. If you had pressure to fill OJT slots only with a particular kind of person, employers might react differently. Another thing you have to say something about, of course, is the level of subsidy. If one subsidy won't do it, that doesn't mean another subsidy won't.

Dr. Piore: After all they *are* businessmen, they *must* respond to some subsidy. From the employer point of view, however, I think that responding to a subsidy is viewed as going out of the business they are currently in—the business of producing goods—and into the training business. A toothpaste manufacturer views responding to a training subsidy very much as he would view going into food processing. Of course, quite apart from its size, one of the problems with the subsidy now offered for on-the-job training is the bookkeeping. Employers claim that in order to participate they must set up a whole new set of books. And they insist it isn't worth it.

Dr. Doeringer: You also run into that in research, I might add. A lot of the on-the-job training programs that have been set up require the employer to do something different in the way of running his business. Moreover, just as he can't readily identify the cost of informal on-the-job training, he is suspicious that many of the costs associated with on-the-job training under MDTA will not be discovered or reimbursed.

Many of the employers I have talked to have considered an MDTA program. One of the main constraints is that they fear they are not going to be subsidized for the full cost of the program. They don't know what the full costs will be, but they feel they are not going to be able to identify all of the costs and then write them down on an accounting form and present the Government with the bill.

I would also like to make one remark regarding the optimism or pessimism with which the integration of disadvantaged groups into the job structure of the economy might be viewed. Dr. Piore and I have somewhat different views on this, but I feel that employers, under the pressure of demand, are interested in reaching out and getting labor. If they discover that there are workers available in urban ghettos and they are having trouble recruiting, then they become interested in these groups. They begin to wonder what it takes to get them to the plant. They see some very easy things, like lack of transportation, and they begin to search for solutions. This is cause for optimism.

Employers, however, continue to think in terms of adjustments that they already know how to make. They have had experience with certain kinds of adjustments in looser labor markets. The current labor market in some areas, especially Chicago and Milwaukee, requires employers to develop brand new ways of dealing with brand new problems. A Negro high school dropout living in a ghetto 15 or 20 miles from the site of the job is a new problem. This learning process which employers must go through because they haven't succeeded in solving the adjustment problem is a cause for pessimism. You find that many employers are not getting people from the ghettos into their plants through their own activities.

Given enough time and labor market pressure, employers will discover the necessary labor market innovations. Here Government programs can contribute by helping provide employers with information about successful techniques, so that they can develop appropriate strategy, and thereby shortcut the trial and error process.

Dr Somers: This is a good investment for an employer from a philanthropist's standpoint. Many employers are taking on Negroes because they think it is their public duty, but I don't think that is ever going to solve the problem of Negro unemployment.

Dr. Doeringer: Look at statistics for Plans for Progress, for example. The number of Negroes that Plans for Progress has brought into the plants is disappointing. So I think that, in terms of charity or public interest, employers are not going to deal with the problem in a significant way unless, in their own self interest, it becomes necessary for them to recruit actively among less preferred groups.

Dr. Mangum: I would like to add one note relevant to the question of need for subsidies. There has been a great deal of interest in Chicago in the JOBS NOW program. Here is a program that is taking in approximately a hundred boys every 2 weeks; it is having a 25-percent success rate with what is a real tough group. This is probably not a bad record. The Labor Department, I understand, tried to give these people money to amplify their program and they refused it. They said, "We think we might come up to 125 boys every 2 weeks but we don't have the staff for more; more importantly, we think we have just about exhausted the willingness of Chicago to hire these boys under the present program." I suggest that this is not an awful lot of boys. Some employers have been socially minded, but not many. Something more would have to be added to get very many more boys into this kind of experience.

Mr. McMillin: Another approach, it seems to me, offers some promise. For example, the Milwaukee Vocational and Technical School has started a new program I am sure you are familiar with. It's called a "Continuation School," located in a new facility adjacent to the present school, serving disadvantaged white, Negro, and other minority youth—500 potential school dropouts each year aged 14 to 18, enrolled in a unique program before they drop out of school. Many of these young people have long lists of failures. They have a history of various types of juvenile delinquency problems, and other identifiable disadvantage problems. The school is running them through an extensive counseling and debriefing program to try to remove some of the hostility factors that have developed from environmental and other conditions. Then, hopefully, they are moved into a program of intial training which will eventually qualify them for employment. You will also be interested to know that similar programs on an experimental basis are now underway in a number of schools throughout the country. The Milwaukee experimental program looks very promising in preventing young boys and girls from dropping out of school, and for eventualy finding them employment, because it has the full cooperation of business and industry in the Milwaukee area. The aim is to work very closely with all community groups in an effort to rehabilitate youth through a preventative type of program, which is one of the critical needs of the disadvantaged.

As many of you know, before the passage of the Vocational Education Act of 1963, vocational education programs were not reaching these kinds of students. The George-Barden and Smith-Hughes Acts were specific in the kinds of occupational training programs covered. They had to be used for programs of agriculture, home economics, distribution and marketing, health, technical, and trade and industrial training and could not be used for establishing occupational training in other areas, particularly in new occupational areas especially relevant for the disadvantaged.

Under the 1963 act, programs for the kinds of students we are talking about here are specifically included, and States are starting to move in developing programs in these areas. In 1965, 28,000 were enrolled in programs for persons with special needs; 52,000 were enrolled in 1966; and an enrollment of more than 300,000 was projected for fiscal 1967. In these programs, disadvantaged youth are enrolled in programs geared to their interests and abilities. This will certainly have an impact on all disadvantaged youth, as well as on the probable million school dropouts each year, before they reach the point of dropping out of school and becoming unemployed. There is real hope in this preventative approach by our public schools for meeting the needs of the disadvantaged, both white and minority youth, in urban and rural areas.

DR. ROSEN: I, for one, would say that the Manpower Administration is extremely pleased with what we have been able to get out of this particular conference. We have enough research ideas for the next 10 years, and this is one of the reasons we held this meeting. I believe we have really discovered a very good method for communicating—and for stimulating—research ideas.

Those of you who are interested in manpower research have been given our guidelines for submitting research proposals. If this meeting has stimulated your thinking or you have some innovative ideas for research in the manpower field, we would be pleased to receive proposals. Thank you for participating in this meeting.

INTERNAL LABOR MARKETS, TECHNOLOGICAL CHANGE, AND LABOR FORCE ADJUSTMENT

SUMMARY

The central theme of the present study is that differences between the skills and abilities of the labor force and the requirements of blue collar jobs in manufacturing are reconciled through a series of instruments over which the employer, alone or in conjunction with a labor organization, exercises discretionary control. It presents a model of the process of adjustment between the labor force and the requirements of blue collar manufacturing jobs which has been derived from material gathered in interviews with management officials in a sample of firms. While it has broader applications, the report focuses upon the process of adjustment to technological change.

The model departs from the conventional view of the labor market by recognizing a market internal to the manufacturing plant which is connected to the external labor market at a limited number of entry ports. The operation of the model may be characterized by eight variables:

- —The job structure of the plant.
- —The administrative rules governing the internal allocation of labor.
- —The size and character of the labor force outside the plant.
- —Recruitment procedures.
- —Screening procedures.
- —Training procedures.
- —Hiring standards.
- —Compensation.

These variables constitute both major determinants of the plant's labor costs and the instruments through which the plant adapts to changing technology and labor market conditions. Since each variable has a cost attached to it, the mode of adjustment selected by the plant will presumably reflect attempts to minimize these costs.

In neoclassical labor market models, the job structure of the plant is assumed to be responsive to differential availabilities of various labor skills as measured by relative wage rates. This study, however, does not support that assumption, at least during relatively loose labor market conditions. While employers considered possibilities of substituting capital for homogenous labor inputs, they did pay close attention to the possibilities of substitutions among different grades of labor. In examining the factors which influence the changes in the job structure, relative market constraints did not appear significant. Indeed, the technical difficulties in identifying qualitative manpower requirements for new equipment prior to its installation on the plant floor make it unlikely that such constraints will become operative. For purposes of labor force adjustment, therefore, changes in technology may be viewed as evolving autonomously from relative wage rates (or more generally relative labor costs), rather than as a factor cooperating with other adjustment instruments. The variable which appears to carry the major burden of adjustment is in-plant training, although recruitment, screening, and hiring procedures are also relevant.

The study indicates that private adjustment mechanisms reliably and efficiently eliminate, at least for blue collar jobs in manufacturing, imbalances between job requirements and the characteristics of the labor force. It appears, therefore, that the concern in recent years with the contribution of technological change to the structural components of unemployment has been misplaced. Since these mechanisms operate at a cost, however, there may be cause for concern with their effect upon the price level. The study suggests that Federal manpower programs should be directed toward the following objectives:

1. To provide general training outside the plant in basic mathematical and verbal skills. Programs of this kind will capture economics of scale in formal training and enhance the occupational flexibility of the labor force.
2. To subsidize in-plant training programs where there is a likelihood that adjustment costs will be translated into price increases.
3. To subsidize experimental training, screening, and recruitment programs as an incentive to developing new in-plant adjustment techniques.
4. To develop procedures for increasing the flow of information among plants about the various adjustment techniques currently being utilized and their relative costs.

1. INTRODUCTION

This project was originally designed to investigate the impact of changes in production techniques upon production and maintenance jobs in manufacturing, and to gage the labor force adjustments these changes required. The study was conceived within the confines of conventional economic theory and was to be based upon material gathered from a sample of manufacturing plants. During the early plant visits, however, it became apparent that the conventional analytical apparatus could not comprehend the processes of technological change and labor force adjustment. The focus of the study therefore shifted to the precedent task of developing a more satisfactory analytical framework. Such a framework is presented in this report. While the problems of technological change and the adjustments to it are examined, the analytical framework is, we believe, applicable to a wider range of economic and industrial relations problems. In this sense, the discussion of the problems associated with technological change may be viewed as an exemplary application of a much more general approach.

The analytical framework centers upon the concept of the internal labor market. The salient feature of the internal labor market is a set of rules governing the allocation of labor within an administrative unit, such as a manufacturing plant. These rules distinguish between employees within the plant and workers in the external market by according to the former certain preferential rights in the filling of plant jobs. Their existence implies that the function of labor allocation, performed in theory by the market, has to a degree been internalized within the plant. The internalization of labor allocation is accompanied by the internalization of a number of other functions. Among these are the pricing, training, recruitment, and screening of labor.

Given the existence of the internal labor market, the relationship between the firm and the external market may be described by a series of eight variables: (1) The job structure of the plant; (2) the administrative rules of the workplace; (3) the size and characteristics of the labor force outside the firm; (4) recruitment procedures; (5) screening procedures; (6) hiring criteria; (7) training procedures; and (8) compensation. These variables constitute the major determinants of the plant's labor costs. They also constitute instruments through which the plant adapts to the external market. For example, if the character of the externally available labor supply changes, the firm should seek to adjust these instruments so as to minimize its costs. In addition to external market conditions, the costs of the various instruments are affected by a variety of technical and institutional constraints, changes which will also induce adjustments within the firm. Production technology may be viewed as one of these constraints. The concept of the internal labor market is developed in chapter 2, and the various instruments of adjustment are discussed in sequence in chapters 3 through 6, the administrative rules in chapter 3, recruitment, screening, and compensation in chapter 4,the job structure in chapter 5, and training in chapter 6.

Since, from the point of view of the firm, these variables are competing modes of adjustment and the decisions concerning their use are interrelated, some justification for the present approach is called for. In part, a separate discussion of the variables is dictated by the impracticality of attempting to discuss them all simultaneously. The particular sequence of discussion, however, reflects to a large extent the decision-making process within the firm. The firm solves what is in principle a set of simultaneous economic equations through a series of separate decisions. In general, decisions concerning changes in technology are made separately from those concerning recruitment, screening, compensation, and training. The firm then provides the requisite adjustments to the job structure through these instruments. The rules governing internal labor allocation also tend to be considered separately by the firm. They are subject to institutional constraints that permit them to change only gradually. In the short run, therefore, such rules are relatively inflexible and tend to be treated as fixed inputs in decisions relating to other variables.

The study is based upon a series of interviews with managerial officials in 20 manufacturing plants belonging to 14 different companies. Interviews were also conducted at the corporate headquarters of nine of the companies. In addition, interviews were conducted at the corporate headquarters of a company producing aluminum and aluminum products and with officials of a custom engineering firm designing power generating stations and chemical processing plants. In the main, the officials interviewed were either engineers or personnel and industrial relations managers. Brief conversations were held with departmental foremen during plant tours. The interviews were open ended, the majority lasting 2 to 3 hours. Most of the visits to the plant lasted for a single day; the longest visit covered 3 days.

Because of the extensive nature of the interviews and the sensitivity of the areas of inquiry, considerable cooperation on the part of the plant management was required and personal contacts were needed to obtain it. A scientific sampling procedure was not, therefore, feasible. An attempt was made, nevertheless, to select a heterogeneous group of plants. The characteristics of the plants are summarized in table 1. The attempt at heterogeneity was only partially successful. While a variety of industries and several different types of labor markets are represented, most of the plants are large units in still larger multiplant corporations. Only three single-plant companies are represented; two other companies in the sample had two plants each. The range of labor market conditions encompassed in the sample is also narrow; save for certain craft skills, all of the labor markets were, at the time of the study, relatively loose. The range of experience encompassed by the study has been somewhat expanded by reference to the literature and by encouraging respondents in the interviews to compare current practices with those under different labor market conditions in which they had worked and in other industries about which they were knowledgeable.

TABLE 1. CHARACTERISTICS OF PLANTS COVERED BY SURVEY

Industry	Number of production and maintenance employees in plant	Location of plant	Character of community[1]
Aircraft engines			
Plant A	4,200	Middle West	Large metropolitan area
Plant B	350	Middle Atlantic	Large metropolitan area
Apparel	350	Middle Atlantic	Large metropolitan area
Chemicals	600	Middle West	Small city
Electrical equipment			
Large power generating equipment	5,500	Middle Atlantic	Large metropolitan area
Consumer appliances	1,700	New England	Town
Electronic parts and equipment			
Plant A	7,000	New England	Town
Plant B	4,600	Middle Atlantic	Small city
Food Processing			
Plant A	1,300	Middle Atlantic	Town
Plant B	75	New England	Town
Plant C	450	New England	Large metropolitan area
Plant D	900	Middle Atlantic	Large metropolitan area
Foundry			
Automobile parts	2,100	Middle West	Large metropolitan area
Heating equipment, Replacement parts	300	Middle Atlantic	Town
Shoes			
Men's			
Plant A	600	New England	Small city
Plant B	350	New England	Town
Women's			
Plant A	500	New England	Town
Plant B	500	New England	Small city
Toilet articles			
Plant A	250	Middle West	Large metropolitan area
Plant B	250	New England	Large metropolitan area
Machine tools	3,000	Middle West	Large metropolitan area
Others:			
Custom engineering firm	[2]	New England	[2]
Aluminum company	[2]	Middle Atlantic	[2]

[1] The communities are classified by population in 1960 as follows: Towns: less than 15,000 population; Small cities: less than 100,000; Large metropolitan areas: over 1,000,000 population.

[2] Data not available.

2. THE INTERNAL LABOR MARKET MODEL[1]

The internal labor market is an administrative unit within which are performed the market functions of pricing, allocating, and often of training labor.[2] It is governed by a set of institutional rules which delineate the boundaries of the internal market and determine its internal structure. These institutional or administrative rules define relationships between jobs for purposes of internal mobility and any privileges which accrue to workers within the internal market. Thus, neither jobs nor workers in the administrative unit may be considered independent of one another. A single or multiplant enterprise, a union hiring hall providing manpower for a number of different enterprises (as in longshoring or construction), and a branch of the military service are all examples of such administrative units. In many cases these units may be further divided into internal submarkets for broad categories of workers such as managerial, clerical, maintenance, production, and the like, each of which is governed by its own specific set of rules.[3]

Internal labor markets have geographical, occupational, and product dimensions. The administrative regulations and procedures controlling the hiring and internal patterns of allocation of labor create a distinction between the employment rights and opportunities of those workers within the internal market and those in the external labor market. Workers within the market typically have the opportunity to express preferences and exercise priority rights over internal jobs which are denied to workers in the external market. In manufacturing plants, for example, the rules that apply to seniority districts, promotions, layoffs, internal grievance procedures, and the like, reflect the preference, and frequently the obligation, of employers to fill certain jobs from within the plant.

Each internal labor market contains one or more jobs or positions through which workers in the external labor market, those workers without preferential employment rights who are seeking jobs, can enter. Examples of these

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[1] Some of the material in this and the subsequent chapter appears in Peter B. Doeringer, "The Determinants of the Structure of Industrial Type Internal Labor Markets," in *Industrial and Labor Relations Review*, (Ithaca: Cornell University), vol. 20 No. 2, (January 1967).

[2] See John T. Dunlop, "Job Vacancy Measures and Economic Analysis," in *The Measurement and Interpretation of Job Vacancies*, (New York: Columbia University Press, 1966), pp. 27–47. Dunlop defines the internal labor market as, "the complex of rules which determines the movement of workers among job classifications within administrative units, such as enterprises, companies, or hiring halls. These movements may be transfers, promotions, demotions, or layoffs to the exterior labor market; they may be temporary or permanent, which may affect the operation of the rules," (fn. p. 32).

[3] These patterns of structure are not rigid, but rather are a function of a number of influences of both an economic and a noneconomic nature.

"ports of entry"[4] are hiring jobs in manufacturing markets and apprenticeship programs and journeymen qualification examinations in craft groups. Admission to the internal labor market is based upon the existence of one or more ports of entry and the possession of certain qualifications or selection criteria that are usually established as conditions for entry.[5]

In most internal labor markets, however, the number of ports of entry is limited by the practices of internal promotion and upgrading of apprentices. Moreover, once the worker gains entry into an internal labor market his tenure in the market is secure against underbidding by workers in the external market, providing that he continues to meet required work performance standards. Once the direct entry from the external labor market into certain jobs is limited or closed, the distinction between workers in the external and internal labor markets becomes significant.

Attached to each entry port are a variety of selection preferences of hiring officers for various types of training and experience, which constitute entry criteria designed to screen out unacceptable entrants. These criteria, expressed often in terms of educational attainment, aptitude test performance, experience, physical fitness, and so forth, create perceived "quality" and availability distinctions among workers in the external labor market. Entry standards may vary with the tightness of the labor market, as well as with the nature of the work to be done.[6] The opportunity to select workers from different quality levels to fill a particular entry job adds another dimension to the process of acquiring an internal labor force.

Similarly, ports of exit from the internal labor market exist. In all such markets, with the possible exception of those under military regulation, the worker is nominally free to quit his job, to relinquish his union affiliation, or to remove his name from a labor referral system, and to leave the internal market. Thus, the internal market is completely open for purposes of voluntary exit including voluntary retirement or the exercise of disability options. There are, however, a number of rules which determine the location of the exit ports in the job structure of the market and the conditions under which involuntary exit and the loss of job rights will occur. Rules relating to temporary and permanent layoffs, sabbatical leaves, termination for lack of work or disability, discipline and discharge, and compulsory or early retirement all control the exit of the worker from the internal labor market.

The scope of the internal labor market and the location of the ports of entry and exit are not immutable, nor are the internal rules which control movement and eligibility. The contours and entry ports of a particular internal labor market will be determined, in part, by such variables as the size of the plant, the technology of the work performed, the product market conditions, and the availity of suitable skills on the external market. As these internal and external environment variables change, the contours of the internal market and also its internal structure may be adapted to the new conditions.

The boundaries of the internal market and the internal system of employment rights may also vary with the particular purpose for which the market is being used. The relevant internal market unit for layoffs will often differ from the unit for promotions or lateral transfers. Similarly, the internal movement patterns followed for temporary promotions, layoffs, and transfers may not be the same as those used for permanent moves.[7] Moreover, one set of allocation rules may apply to the filling of vacancies in an existing job structure, while a different procedure may be used if new jobs, departments, or even plants are established.

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[4] Clark Kerr, "The Balkanization of Labor Market," in *Labor Mobility and Economic Opportunity*, E. Wight Bakke et al. (contributors), (Cambridge: Technology Press of M.I.T., 1954), p. 101.

[5] The location of entry ports and the nature of entry qualifications are a function of variables such as the job content relationships of the internal job structure and the external availability of skills.

[6] See Richard A. Lester, *Hiring Practices and Labor Competition*, Princeton University Research Report No. 88, (Princeton: Princeton University, 1959).

[7] See Sumner H. Slichter, James J. Healy, E. Robert Livernash, *The Impact of Collective Bargaining on Management*, (Washington: The Brookings Institution, 1960), pp. 154–210, for a discussion of various internal market patterns for promotions and layoffs.

Within each internal market a number of submarkets may exist. These may be broad, internal market divisions such as managerial, clerical, production, and maintenance, or they may be broken down further into departments or other narrower groups. The pattern and sequence of movement within these subgroups and the linkages between them constitute the allocative structure of the internal labor market. The scope of the market for each such subgroup need not be the same. In multi-plant companies, for example, supervisory personnel are typically transferred over a wider geographical area than are production workers.

Once the rules determining the routes for internal movement—the internal allocative structure—are established, they must be supplemented by a set of rules that rank the workers in the internal labor force in order of their priority for movement for purposes of rationing job vacancies. Commonly these rules rely upon various combinations of ability and seniority for determining the sequence of movement.[8] Craft-type internal labor markets use seniority less frequently than manufacturing markets, but may employ referral criteria based upon frequency of work, attachment to the labor market, need, and the like. Some plants rely primarily upon length of service in determining, within each line of progression in the production and maintenance subgroups, which employees should be given the opportunity for upgrading.

Among other factors, the structuring of the internal labor market in many cases may reflect the influence of training requirements and training costs. The progression ladder from apprentice to journeyman is an example of a vertical pattern of movement based upon the acquisition of certain skills. In many manufacturing plants an attempt is made, whenever possible, to construct promotion ladders and progression lines that follow natural training progressions. By "natural" is meant here the development of skills and experience that derive from the technology and requirements of the jobs in the production process. Moreover, it includes the practice of providing temporary replacements for employees who are absent, sick, or on leave.

Internal training may be either formal or informal. The major part of the training which takes place within the internal labor market is informal, relying principally upon on-the-job training occurring as part of the normal process of promotion and lateral transfer to fill internal job vacancies. Maintenance trainees, production workers, and executives and technical personnel receive a substantial part of their specific job skills by this method. The importance of on-the-job training and the costs of such training to the internal labor market present a marked contrast to the neoclassical model, in which training is acquired outside of the work relationship.

Where such training, both formal and on-the-job, is provided within the internal labor market, it enables the employer to develop the specific skills required by the job structure of the market. By adjusting the quantity and type of training offered to workers within the market, the employer may be able to vary both the skill level and the quality required of new entrants to the market. While this process introduces an additional factor into labor costs, it permits the market to select an internal structure from among a number of alternative hiring, training, and promotion patterns, each with different costs attached to them. It also removes a potential constraint upon the introduction of new machinery, since the employer need not rely exclusively upon the availability of particular skills on the external market. This ability to respond to changing conditions in technology, product markets, and labor markets through the training variable is essential to the operation of the internal labor market.

Just as the boundaries of the internal labor market are subject to change, so is the internal structure. The creation of new jobs may require the modification of promotion ladders; a decline in employment opportunities may result in broader layoff districts. A shortage of maintenance skills on the external labor market may produce new training programs or training linkages between production and maintenance subgroups. One automobile plant, for example, has established a temporary, skilled-crafts job through which production workers may be upgraded to maintenance jobs when such skills are unavailable on the external market. And an electrical equipment plant opens an automatic screw-machine operator's school whenever requirements for this skill cannot be filled by hiring on the outside.

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[8] See E. Robert Livernash, "The Internal Wage Structure," in George W. Taylor and Frank C. Pierson, *New Concepts in Wage Determination*, (New York: McGraw-Hill, 1957), pp. 140–172.

The rules governing the ordering of workers for internal movement may also change. The relative weighting of ability and seniority may be modified as internal skill requirements shift. Specific educational and aptitude criteria or previous job experience requirements may also be revised as the nature of jobs changes. Entry criteria may be modified in a similar way in response to the same variables.

The ability to vary recruiting methods, hiring standards, and other entry criteria, the quantity and quality of internal training procedures, and even the job structure, through changes in machinery and work methods, permits the internal labor market to adapt itself, structurally and operationally, to changing conditions among the variables that affect it. These variables each have costs attached to them—costs that arise in the process of adapting and distributing the internal labor force among the jobs in the internal market. To these costs must be added the cost of labor turnover, the replacement cost of workers who leave the market either voluntarily or involuntarily. Wage level, structure and methods of wage payment, working conditions, pensions, health and welfare plans, employment security provisions, and the like, all influence the rate of voluntary attrition and may be viewed, in part, as a means of reducing the costs of turnover.

Rules relating to retirement and other forms of termination control the rate of involuntary separation from the market. The costs associated with the various rules governing entry, exit, internal movement, training, and wage setting suggest that these structures may be evaluated, at least by economic standards, in terms of their cost per unit of output.

While the internal labor market has been described in terms of the economic influences upon the fabric of rules governing internal labor mobility, training, and remuneration, which so markedly distinguish it from the neoclassical model, there also exist certain social forces that may contribute substantially to the functioning of the internal market. In the internal labor markets where jobs can be expected to be reasonably permanent, social employment relationships will be developed that are predicated, either formally or informally, upon the expectation of continuous employment.[9] Such continuity assumes a set of market rules that are in some sense considered equitable by the parties in the market. Where such equity is absent, the continuity of the work relationship is likely to be quite tenuous. The social environment of the internal labor market need not necessarily produce peaceful relations between the parties. Indeed it may be characterized by conflict and mutual antagonism, but such conflict must, in the long run, be limited by the ability of the market to survive it.

These social factors, which influence internal labor supplies, productivities, and costs, are not easily integrated into an economic model. Especially where the administrative regulations of the market reflect bargaining compromises, personnel philosophies, customs, and traditions which are influenced by noneconomic objectives, the structure of the internal market may appear inefficient and perhaps even irrational by objective economic standards. Some of the diversity of structures found in internal labor markets operating under similar economic conditions may be traced to these social forces. The internal labor market model, when used as a tool of logical analysis, is based upon the assumption of economic rationality. It recognizes the existence of the noneconomic forces, but it is limited in its ability to integrate them adequately into its system in order to predict the balance with the economic forces, which produces the observed structure of an internal labor market.

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[9] Hicks states the conditions for the appearance of such social aspects of work as: "(1) that the worker should be free to change his employer . . . (2) that employment should be regular." (John R. Hicks, *The Theory of Wages*, [2d ed., London: MacMillan and Co. Ltd., 1963], p. 317). The permanency of a job, however, is not a necessary condition for such a social work relationship. Many of the same principles apply to casual jobs, such as are found in the construction crafts and longshoring, where work "teams" may remain together from job to job.

Probably the most familiar type of structured internal labor market is the industrial enterprise. The types of allocative structuring within the internal labor markets of such enterprises may be characterized by a threefold classification scheme: (1) by the degree of openness to the external labor market, as determined by the number and location of the ports of entry, (2) by the dimensions, both horizontal and vertical, of the units for upgrading, downgrading, lateral transfer, and layoff, and (3) by the rules that determine the order of priority in which workers will be distributed among the jobs within the internal market.

Ports of Entry

Ports of entry into the internal labor market occur within each broad internal submarket—blue collar, clerical, managerial, and the like. The location of these entry ports is not fixed, however, but will typically respond to changes in the labor market conditions, in the rate of expansion of job vacancies within the plant, and in the technology of the production process.

For purposes of classification, two extreme types of internal market structures, closed and open, may be postulated. The closed internal market has only a single entry job classification, all other jobs in the plant being filled internally through upgrading. While no plant in this study exhibited such a closed structure, it is not impossible to find examples of plants that normally hire into a single job classification for all production and maintenance work. Some plants, notably in steel and petroleum, prefer to develop most of their blue-collar skills, including maintenance and repair skills, internally and so follow a practice of hiring exclusively into low skilled jobs.[10]

At the opposite end of the classification spectrum is the open internal labor market, which fills vacancies in all job classifications from the external labor market. Again no example of such a completely open internal labor market structure was encountered in this study. A men's clothing plant, however, did demonstrate a considerable degree of openness in its production job structure. Vacancies in any stitching job classification and in most of the pressing job classifications were filled directly from the external market.

In most industrial plants, however, the proportion of entry job classifications lies somewhere between these extremes. Typically the hiring ports into production and maintenance jobs are located at the low skilled level—such as maintenance trainee, sweeper, oiler, packer, assembler, and the like—and at the journeyman level. Most semiskilled and highly skilled production jobs are closed to the external market.

In clerical internal submarkets, the number of entry job classifications is usually greater than in blue-collar submarkets, often with each skill or occupational grade providing an entry port. Mailclerks, clerk typists, stenographers, secretaries, and executive secretaries may all be hired from the external labor market, although some formal internal clerical progression ladders do exist in which only the bottom jobs in the progression are filled from the outside. Examples of such progressions would be blueprint machine operator to addressograph operator to reproduction machine operator and junior payroll clerk to senior payroll clerk.

For most management and professional jobs, a policy of internal training and promotion is followed where possible, although experienced executives, scientists, engineers, and the like are hired when suitably trained or experienced employees are not available for upgrading. Professional personnel, such as lawyers and physicians, are often brought directly into the plant to function in a specific occupational capacity at a skill and pay grade commensurate with their education and experience.

Formal inplant training programs may provide another, albeit rather specalized, port of entry. Some companies run training programs to prepare entrants for particular jobs or progression patterns, usually of a skilled nature. For example, entry training programs for management trainees usually consist of formal training lectures and orientation programs combined with rotating job assignments designed to give the trainee broad exposure to all or part of the company's functions. Production or maintenance training programs, providing skills such as drafting, planning, computer programing, computerized equipment maintenance, and the like may also serve as entry ports. The purpose of hiring into these training programs, as opposed to entry jobs, may be twofold: (1) to provide the plant with needed skills, through formal training programs, more quickly and efficiently than through alternative routes in the internal labor market, and (2) to provide special entry ports into the production and maintenance submarkets, which have higher educational and aptitude requirements than are found necessary for conventional low skilled entry ports.

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[10] For a study of an internal labor market that develops all of its maintenance and operating skills through internal training and upgrading, see *A Case Study of a Modernized Petroleum Refinery;* (Washington: U.S. Department of Labor, Bureau of Labor Statistics, 1957), Report No. 120.

Patterns of Movement

For purposes of internal movement, jobs in the internal labor market are grouped into progression lines, departments, plantwide and multiplant districts, and so forth. The dimensions of these job groupings define the scope of the district within which an employee may be upgraded, downgraded, transferred, or laid off. The contours of these districts may vary with the type of movement (i.e. promotion, layoff, etc.) and are determined by the technology of the production process, predictable fluctuations in product demand, external labor market conditions, and such considerations as equity and custom. For purposes of classifying industrial internal labor markets, the vertical dimension of the movement districts is defined by the range of the levels of job content within the district and the horizontal dimension by the number and degree of specialization of the job classifications within any level.

In this study, the broadest district for upgrading encountered in the production internal submarket was plantwide. Within such a district, any production job vacancy is opened to all the production workers in the plant. Employees are then assigned to or have the opportunity to fill the vacancy according to the internal application and selection procedure of the plant. Since the number of applicants usually exceeds the number of job vacancies, the internal selection procedure serves to ration the limited vacancies among the excess supply of workers.[11] The plantwide districts are typically associated with production job structures containing a relatively small range of variation in levels of job content and low proportion of specialized jobs.

A somewhat more narrow district for upgrading involves the division of production jobs into departments. The division is based upon the production process, the nature of the occupations, the product type, or the administrative organization of the plant. In some plants—steel, chemicals, and petroleum for example—the districts for upgrading are even more narrow, consisting of specific lines of progression within each department. These progression lines may be only one job wide or may consist of several branches. When upgrading districts are narrow and interjob mobility linkages carefully defined, the upgrading sequences usually reflect a skill development sequence. The range of job content and the proportion of specialized jobs is usually greater in those plants with narrow upgrading districts than in plants with broad districts.

The extreme type of narrow internal labor market district consists of only a single job classification and emphasizes the uniqueness or independence of each type of job in contrast to multiclassification districts, which recognize the skill and experience relationships among the jobs in the internal market. These single job districts appear when the job classifications in the plant are highly specialized. An example of such narrow districts is found in the production submarkets in men's clothing manufacturing.

The production jobs in this internal labor market can be separated into three main categories—pressing, stitching, and cutting—cutting being the highest skilled and stitching being the largest. While the jobs within each category have certain common elements of skill, only in cutting and in some pressing classifications do upgrading progressions exist; all vacancies in stitching classifications and most of the pressing jobs are filled directly from the external labor market.

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[11] See E. Robert Livernash, "The Internal Wage Structure," in Taylor and Pierson, op. cit., p. 143.

Since substantial training times, sometimes as long as a year, are required to achieve job proficiency, and a piece rate method of wage payment is used, the disruptive effects of internal mobility upon efficiency and earnings at least partially explain the existence of internal market districts containing only single stitching or pressing job classifications. Moreover, the industry has followed a philosophy of work sharing, within certain limits, so that downgrading and layoff patterns have not traditionally been important.

While the patterns of movement have been discussed in relation to upward mobility within the job structure of the plant, technological change, changes in product models or product mix, and declining output may lead to downgradings and layoffs. In some plants the downgrading and layoff districts may coincide with the upgrading districts, but this is not necessarily the case. In a number of the plants studied, the layoff districts, and often the downgrading districts, were broader than the upgrading districts in order to enhance the employment and earnings security of some groups of surplus employees. When progression lines were used within department districts for upgrading, for example surplus employees might be allowed to exercise seniority-based bumping rights into jobs within their departments which lay outside of their progression lines. In some plants surplus employees in job classifications that cut across departments, such as maintenance mechanics or welders, were allowed to bump laterally within their classification into other departments. Similarly, one plant in this study developed a "trial job" concept, which defines specific interdepartmental downgrading patterns for each job in the plant, although upgrading is always intradepartmental.

For layoffs many plants have established interdepartmental transfer linkages among low skilled jobs, which allow surplus employees in one department to bump less senior employees in another department, so that the least senior employees within a multidepartment district are laid off. Presently in the basic steel industry, for example, the interdepartmental linkages in some plants assume the form of a labor pool or "pan," containing the bottom three or four job grades, which a number of departments share in common. Workers exercise their bumping rights within departments until they reach the labor pan, where their bumping and layoff rights become interdepartmental or even plantwide.[12] Even when employees are laid off, however, they maintain an internal market attachment. While employees on layoff are not at work, they still have "jobs" in a significant sense, especially when layoffs are of a temporary nature, since they possess recall rights to employment.

Priorities for Internal Movement

The final dimension of the classification system for industrial internal labor markets is the set of rules governing the priority of movement within the internal market. The rules that define these priorities and rank workers for purposes of internal movement rely primarily upon the factors of ability and seniority. These rules decide the order in which employees within relevant internal groupings of job classifications —seniority district, progression ladder, department, or the like—will receive promotions, transfers, downgradings, and layoffs.[13] For promotions such rules are supplemented by others governing the type of choice permitted employees in selecting or accepting internal reassignment; for downgrading they are supplemented by the nature of the bumping rights possessed by the employee.[14]

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[12] See Slichter, Healy, and Livernash, op. cit., pp. 157–68.

[13] These rules, especially those relating to seniority, may also be used for establishing other forms of priority rights, such as vacation periods, parking privileges, shift preferences, and overtime.

[14] Especially in the case of layoffs and downgradings, where the equity of employment and earnings security is important, the internal movement district, the rules governing movement priorities, and the employee's bumping rights must be viewed simultaneously in order to understand completely the operation of the internal market. (See Slichter, Helay, and Livernash, op. cit., pp. 157–58).

The plant that uses straight senority for determining all internal movement priorities and the plant that recognizes ability factors exclusively in determining such priorities constitute the limits of the range of types of movement priority systems. Most plants employ some combination of these criteria, although the particular combination will vary with the type of movement.

The formal use of the rules governing internal movement priorities, as embodied in collective bargaining agreements and unilaterally imposed rules of the work place, is not new.[15] Plans to define the order in which layoffs occur, the formal commitment by employers to give first consideration to internal promotions in filling job vacancies, the appearance of seniority as an explicit criterion in determining layoffs and promotions, and the development of internal dispute settling mechanisms to police the application of these rules have, however, become more influential within the past 20 years or so. This increased influence can be traced to the growth of collective bargaining in industrial plants, to changes in management's views of its "prerogatives," and possibly to the decisions promulgated by the War Labor Board during World War II.[16]

The rules governing the priorities for internal movement are supplemented in many cases by additional rules defining the process by which workers may select or accept upgradings, downgradings, layoffs, and transfers and the way in which bumping rights can be exercised during reductions in force. A spectrum of worker choice in selecting or accepting internal interjob transfers may be envisioned with voluntary acceptance of a new job assignment at one end and mandatory acceptance at the other. The extreme case whereby workers are assigned to jobs without exercising any choice is typical of the operation of the noncivilian sectors of the military service. Most plants in this study, however, permitted some form of employee choice in the movement decision.

For example, job vacancies were frequently "posted" or opened to workers within a particular promotion district or submarket. These workers could then express their desire to be assigned to the vacancy by filling out an application or "bid" for the job. The employer would then fill the vacancy from among these bids on the basis of the criteria described above. An alternative method required workers to file bids in advance of job vacancies, so that a list of applicants for any job was always available. When no one applied for a vacancy, some plants would expand the area of internal selection to permit a broader group of employees to apply. Other plants would assign the least senior worker in the department or plant to the job or else seek to fill the vacancy from the external market.

During downgrading the bumping rights of an employee also constitute a component of the internal selection process, as those rights exert an influence over the ordering of employees for internal movement. Within the district in which a surplus employee is allowed to exercise his bumping rights, several types of bumping patterns may occur. Chain bumping, in which a bump by one surplus employee may lead to a number of consecutive bumps by other employees until an employee is finally laid off, produces the greatest number of moves per surplus employee. Alternatively, rules may exist which curtail the number of bumps which may occur in the plant by requiring that a surplus employee bump directly into a low skilled labor pan or by establishing arbitrary seniority limits upon bumping, so that, for example, an employee with 10 years seniority may also bump into jobs held by employees with 5 years or less seniority. Frequently the scope of the downgrading district is balanced by such rules limiting bumping in order to reduce the costs of the disruptions that accompany the internal movement of workers.[17]

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[15] Internal labor markets containing jobs that were insulated, to some degree, from the external labor market antedated the widespread appearance of formalized rules structures. In a study by Roy W. Kelly, *Hiring the Worker*, (New York: The Engineering Magazine Co., 1918), only 20 percent of the firms surveyed had any formal promotion plans. Only 1 firm in 30 had a plan which involved seniority; the rest relied upon a personal judgment (usually a foreman's) in selecting candidates for promotion. One firm did not replace older workers with younger, more able people, in order to sustain morale. (pp. 27–30) A later survey by Paul Gemmil ("Methods of Promoting Industrial Employees," *Industrial Management*, Vol. LXVI [April 1924]) of a sample of 150 large companies (100 or more employees), found that 141 had a policy of promotion from within. Two of these firms promoted the most senior worker, and 97 used seniority when "merit" was equal among alternative employees. See also Summer H. Slichter, *Union Policies and Industrial Management*, (Washington: The Brookings Institution, 1941), pp. 276–79, 542–43

[16] See Slichter, Healy, and Livernash, op. cit. pp. 154–55, 181–82.

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[17] In addition to the broad classifications of the patterns of internal movement within production and maintenance internal submarkets previously described, there are other institutional rules that contribute to the structure of the internal allocation process. Among these are provisions for transferring employees to new facilities, interplant transfer linkages, and arrangements for filling temporary job vacancies created by vacation, illness, and the like. This classification system can also be extended to various white-collar internal submarkets. See for example, Theodore M. Alfred, "Checkers and Choice in Manpower Management" working paper. Alfred P. Sloan School of Management, M.I.T.

3. THE INTERNAL LABOR MARKET STRUCTURE

While the internal labor model represents a considerable departure from the neoclassical view of the economy, at least one assumption of the neoclassical model was not called into question in any serious way during this study: firms do seek to maximize profits; moreover, it appears that the structure of the internal labor market reflects the firm'sefforts to do so. This may be viewed as one arrangement introduced by the firm to minimize the total cost of production. The internal market structure reflects the conventional economic constraints within which the firm operates; those imposed by (1) technology, (2) the product market, and (3) the labor market. In addition to these conventional constraints, however, there is a set of institutional constraints that also operates within the internal market. While these institutional constraints do not typically appear to prevent the internal market structure from reacting to changes in the economic environment, they do tend to retard its responsiveness to these influences.

The Influences of Technology and Work Methods

In a static internal labor market the most important variables shaping the structure of internal markets, excluding the influence of noneconomic market forces such as custom, are the technology of production and the work methods within the plant. The plant may be perceived as an administrative unit that contains a set of tasks. The technology of the capital equipment and the product mix that must be produced on this equipment define, within certain limits, the skill mix and the proportion of specialized jobs in the job structure of the plant at any point in time. Whatever flexibility that exists in the job structure results from the discretionary fashion in which tasks may be combined to produce broadly or narrowly skilled jobs (i.e., job design) and the decisions regarding the division of the work between internal employees and subcontractors. Within the manning range permitted by such flexibility, the technology of the production process establishes a matrix of jobs whose vertical dimension reflects levels of job content. The mobility linkages between the jobs in this matrix and between the matrix and the external labor market are defined by the hiring, promotion, downgrading, transfer, and termination patterns described in chapter II.

If the process of filling vacancies in the job structure of the plant, from either internal or external sources of labor, were costless, the employer would be indifferent about the possible combinations of patterns of internal mobility and locations of entry ports. However, with every new hire there are recruiting costs, and with both new hires and internal reassignments of employees there are selection costs. Moreover, with every new hire or internal reassignment some training must occur as the employee becomes acquainted with the duties of his new job, and such training, even when provided on the job, as is typically the case with production skills, has certain costs attached to it.[18]

These training costs, often measurable only in terms of reduced productivity, wasted raw materials, damaged machinery and the like, are a direct function of (1) the content of entry jobs and the differences in content among the job classifications, which are grouped together for the purposes of internal movement, and (2) the availability of particular skills in the external labor market. Given the job structure of the plant, the profit-maximizing employer, excluding questions of equity and employee morale, will presumably attempt to establish a sequence of hiring and internal movement patterns that will permit him to fill vacancies in the job structure at the lowest cost. The process of designing jobs and of determining hiring and internal mobility patterns provides one of the primary mechanisms by which the costs of entry training and internal retraining are controlled within the plant.

Once the content of the jobs contained within the internal labor market is established, some jobs will typically be identified as entry ports because of the minimal entry training associated with them. Many of these entry jobs will necessarily be low skilled, but more highly skilled jobs may also be entry ports when there is an expectation that workers possessing appropriate skills will be available on the external labor market. The remaining jobs in the internal market will be filled through upgrading, primarily because experience and training acquired elsewhere in the internal job structure may be at least partially transferred to these jobs. The proportion of the jobs opened to the external market, therefore, will be substantially influenced by the skill mix and specificity of the internal job structure and by the relatedness of content among the jobs in that structure.[19]

The dimensions of the patterns of movement within the internal labor market also are largely determined by job content relationships within the internal job structure. For example, when specific progression ladders defining precise interjob mobility linkages are established, there is typically a logical relationship between the job progression pattern and the process of incremental skill development through on-the-job training. These lines of progression utilize prior internal training and experience to reduce the amount of additional training that must occur following a promotion. Similarly during downgrading, when internal rules require that an employee bump into a job he has performed previously or that utilizes skills previously learned on other jobs in the plant, the amount of retraining is minimized.

If the skill content of most jobs is low, or if skills are similar or overlapping, narrow patterns of movement do not provide significant training economies, and the likelihood of broad departmental or even plant-wide job groupings for purposes of movement is high. When jobs become more specialized and the skill relationships are significantly greater between certain jobs than between others, there is a high probability that narrow districts for internal movement or specific progression ladders will be developed to utilize skill relationships effectively and to reduce the retraining costs associated with the upgrading of employees. A narrow progression line such as stamper—utility man—shearman—manipulator—roller, within the blooming mill department of a steel plant, combined with the broad area of transfer permitted within the low skilled labor "pan" in steel, is a typical example of such internal structuring forces at work. The scope of the internal movement district, in this case, is narrower among high skilled and skill-related jobs than among the low skilled, easily learned jobs.

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[18] The training function of the industrial internal labor market and the costs associated with it will be examined in detail in chap. VI. Recruiting, hiring, selection, and training costs are often influential in determining the outcome of "make or buy" decisions regarding worker skills.

[19] Particular job skills are plant specific when job content is unique to a plant in terms of the high proportion of orientation training to manual skill required, the idiosyncratic content of the job, or the difficulty encountered in adapting work habits acquired elsewhere on similar jobs to job performance in the plant.

When jobs in a plant become highly specialized internally, so that skills learned on one job are not significantly transferable to other jobs within the plant, the internal training sequences diminish in importance. This permits the internal labor market considerable flexibility in both the dimensions of the internal patterns of movement and in the number and location of the ports of entry. The extreme example of an internal labor market, in which a high degree of job specialization has produced a substantial erosion of internal training sequences and has reduced the cost and earnings incentives for establishing internal interjob mobility linkages, is in the stitching jobs of the men's garment manufacturing plant. Since skills and experience acquired on any stitching job in the plant contribute little toward reducing the training time required to learn other stitching jobs in the plant, and long training periods are required to achieve full efficiency on these jobs, a high production cost would be incurred if multiple internal moves occurred in filling job vacancies. Moreover, temporary earnings penalties would be placed upon the workers since piece-rate wages are paid for stitching. Therefore, all of the stitching and most of the pressing jobs represent separate internal submarkets, and are connected directly to the external labor market rather than to other jobs within the internal job structure of the plant.

In the static case, a secondary determinant of the structure of the patterns of internal movement, related to the technology of production, is the size of the internal market. While some small internal market units, such as supermarkets, may be highly structured, the plant with a small internal labor force will often have a very informal market structure. The smallest manufacturing plant examined in this study employed 60 workers and exhibited an internal structure, so it is difficult to judge, from empirical observation, at what minimum employment level a formal internal market structure is likely to develop. It is intuitively evident, however, that such a structure becomes impractical when the internal labor force is small and has highly personalized and informal work relationships with the employer.

As the magnitude of plant employment expands, however, the need for formal structuring increases. When management is required, possibly in a decentralized and impersonal fashion, to develop and implement decisions that affect a large group of employees, pressures toward formal promotion, layoff and transfer policies appear, both to facilitate the administrative process and to establish consistency of industrial relations policies. At some point, however, as the plant increases in size, the administrative difficulties encountered in regulating a large group of employees within a single plant unit or department may encourage the fragmentizing of such a group into more easily managed units.[20]

In the dynamic case, changes in the technology of production will influence the internal market structure. Technological change may result in increases or decreases in (1) the job content and the proportion of specialized jobs in the plant and (2) the employment opportunities within the plant. Only the effects on the job structure will be considered here, the employment effects being included in the discussion of the more general problem of changes in the volume of internal employment.

When technological change creates a different set of tasks, or produces a shift in the existing job mix, the internal labor market has either to acquire from the external market or to develop from within the labor skills required by the changed job structure. When the new jobs are of a low-skilled nature or are closely related to the job structure of the plant prior to the technological change, they can usually be integrated into the existing internal market structure without much modification of the rules. Otherwise, adjustments in the internal market structure must be made.

If appropriate internal training sequences for developing the skills required by the new technology do not exist, the plant faces two alternatives: (1) to develop special training programs, either formal or on-the-job, for the new skills, or (2) to hire pretrained workers from the external labor market. For new and unique types of equipment the selection of the former mode of adjustment is frequently dictated by the unavailability of suitably trained employees on the external market.

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[20] See Robert L. Aronson, *Layoff Policies and Practices—Recent Experience Under Collective Bargaining*, (Princeton: Princeton University, 1950), Research Report No. 82, pp. 15–16.

When the employer chooses to develop the skills for the new jobs largely through internal training programs, a decision must also be made regarding the selection of trainees. For example, in the case of the introduction of numerically controlled laths into an aircraft engine plant, operator trainees were selected, on the basis of electronics aptitude tests, from among highly skilled mechanical lathe operators within the plant. Another plant, introducing computerized production equipment, chose to man this equipment with electronics technicians who were then trained in machine operation and maintenance, while a third company with similar equipment recruited high school graduates with high electronic and mechanical aptitudes to fill its operator training program. The decision regarding the internal or external selection of trainees seemed to be influenced, at least in part, by the types of skills and abilities within the internal labor force that could be brought to the training program. Moreover, it appeared that these training programs were destined to be only a transitory phenomenon, to be replaced at a later date by new on-the-job progression lines.

If job content is altered, the selection standards applied to applicants, both internal and external, for job vacancies in the plant may also change. Rising job content, for example, may result in additional specific or general aptitude and educational hiring criteria, although it appears that such criteria are often more responsive to external labor market conditions than the internal structure of skills. More emphasis may also be applied to ability factors when selecting employees for upgrading or lateral transfer. One petroleum refinery, for example, found that the changing content of its job structure necessitated a transition from a promotion system emphasizing seniority to one stressing ability.[21]

Product Market Factors

In the previous section dealing with the static and dynamic influences of technology upon the structure of the internal market, the product mix and the level of output were assumed to be constant. In a dynamic product market environment, however, both the qualitative and quantitative shifts in demand will often create internal cost and equity stresses, which will exert equally important influences upon the internal market structure.[22]

In plants that produce more than one product, for example, changes in the product mix, without any net change in the volume of internal employment, may result in varying degrees of expansion and contraction in different departments within a plant, which may affect the plant's job structure analogously to a change in technology. Under these circumstances, in some industries the desire to provide greater employment security for employees in contracting departments, to retain certain "key" or skilled employees within the plant, and to utilize some transferable skills, may result in additional interdepartmental transfer linkages beyond those dictated by efficiency criteria in a static internal market.[23] In other industries, where the technology of production permits, these same objectives may encourage work sharing through shorter hours or reduced productivity in the departments with temporarily declining employment and overtime, increased productivity, the hiring of temporary help, and the like in the departments with increased employment.[24]

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[21] See *A Case Study of a Modernized Petroleum Refinery*, (Washington, U.S. Department of Labor, Bureau of Labor Statistics, 1957), Report No. 120, pp. 7, 26. This change apparently produced some dissatisfaction among employees.

[22] Aronson cites this as the most important determinant of the internal market structure. (Robert L. Aronson, *Layoff Policies and Practices—Recent Experiences Under Collective Bargaining*. op. cit., p. 15).This judgment is arguable in view of the significant influence of production technology upon the recruiting, hiring and training costs associated with alternative internal market structures. A more accurate view of the balance between product market and technological influences may be suggested, in which the technology of production and a fixed product mix permit the determination of a least-cost internal market structure under static internal market conditions, while various dynamic cost considerations associated with demand shifts, variations in external availabilities of labor, and the like, encourage modifications of the static structure.

[23] The job structure may also be modified as job content is enlarged to facilitate interdepartment transfers and internal training may be increased by making systematic temporary assignments to broaden workers' skills. See Sumner H. Slichter, James J. Healy, and E. Robert Livernash, *The Impact of Collective Bargaining Upon Management*. (Washington: The Brookings Institution, 1960), pp. 144–145, 160.

Predictable employment fluctations in the internal labor market arising from seasonal or cyclical variations in demand introduce a second dynamic product market influence upon the internal labor market structure. For example, a fluctuating output may encourage broader training of employees by enlarging the content of jobs, and perhaps by establishing wider promotions districts, so that the internal labor force will be more adaptable to upgrading and downgrading. Fluctuations in employment will also influence patterns of downward movement within the internal market. Many internal market structures contain rules that are expressly designed to limit the number of bumps that occur during reductions in forces. The restriction of bumping rights to low skilled jobs and to jobs previously performed are examples of such rules. While some of the costs of bumping are of an administrative nature, the costs of retraining and other adjustments associated with internal job changes are also an important factor.[25] Layoff districts may also be broadened to provide greater employment security for some workers.

Seasonal or cyclical fluctuations in demand may also encourage the dichotomization of the internal labor force into permanent and temporary groups of workers. Typically, the permanent core of production and maintenance employees receives broader internal skill development, is afforded greater opportunities for movement within the internal market, and has considerably more employment security than the temporary employees. The size of the permanent internal labor force will usually be determined by the level of work regularly performed within the internal market. When output, and thus employment, is increased, temporary employees are hired with the specific understanding that their internal employment rights are only transitory, although these employees may be granted preferential opportunities for permanent job vacancies as they appear. These temporary employees are usually relegated to the jobs with low content in order to minimize training costs. Familiar examples of such temporary jobs are found in supermarkets, the postal service, and department stores during certain holiday periods. Frequently temporary employees are also hired in light consumer goods industries for special promotional packing operations, which are labor intensive, and to supplement regularly, on a seasonal basis, the permanent internal labor force.

Change in the employment opportunities within the internal labor market, as a result of secular shifts in product demand, may also encourage a modification of the structure of the internal market. When internal employment is secularly declining, internal market restructuring may occur to increase the job security of at least a portion of the internal labor force. The guarantee of employment, as in one sugar refinery studied, or the extension of preferential employment rights to other plants of a multiplant company are examples of such restructuring.

Accompanying guarantees of employment, or as an independent internal reaction to a reduction in the employment and earnings opportunities within the internal market, the groupings of job classifications for purposes of internal movement may be expanded. When this form of internal market restructuring occurs, adjustments must also take place in the amount of internal training and often in the selection criteria for hiring or for upgrading and lateral transfer. In one electronics plant with declining internal employment a regular training program was developed to enable surplus production workers with clerical aptitudes to transfer to clerical jobs. Less dramatically, a sugar refinery permitted surplus employees with high general aptitudes to transfer laterally between production departments. Typically such transfer rights and retraining opportunities are conditional upon an employee's demonstration of a strong aptitude for acquiring new job skills.

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[24] A somewhat similar situation arises when a plant makes a permanent product shift, such as from mechanical calculators to electromechanical computers, or from aircraft to aerospace or electronics production. The internal market structure will undergo significant modifications when the changing job structure requires substantial retraining of the internal work force and the acquisition of certain additional skills from the external labor market.

[25] Work sharing plans, within limits, may be developed as an alternative to bumping and layoffs where the production process and the method of wage payment permit.

The feasibility of limiting bumping chains may be reduced by employee opposition to earnings reductions arising from, for example, direct bumping from high paying jobs into low skilled jobs with low earnings levels. This problem becomes more serious as the earnings differentials between job grades become wider. During temporary reductions in forces, some employees facing the probability of being downgraded into low wage jobs may receive earnings or wage rate guarantees or may be encouraged, perhaps through liberal SUB payments, to voluntarily accept a layoff rather than to initiate a bumping chain.

Conversely, if the product market is undergoing secular expansion, a restructuring of the internal market may have to occur to insure that an adequate supply of skills will be available at all levels of the job structure. A chemical plant in this study had a policy of opening temporary transfer linkages between related production departments whenever employment opportunities in one department were expanding faster than they could satisfactorily be filled by upgrading employees within its progression sequence. This procedure raised the cost of training, however, since the prior on-the-job experience of employees upgraded from other departments was not as applicable as that of employees upgraded within the expanding department.

When the internal growth of job vacancies is so rapid that the upgrading or transfer sequences cannot develop skills rapidly enough, workers may be brought into the internal market at all job levels, providing, of course, either that suitable skills are available on the external market, or that the employer is willing to provide the requisite entry training. Under these conditions both entry and upgrading may operate simultaneously to fill job vacancies throughout the job structure. In terms of the entry port structure, "there are more ports of entry in a period of prosperity than in a period of depression."[26]

Labor Market Factors

The characteristics of the labor market in which a plant is situated will also provide an influence upon the location of the ports of entry into the plant's job structure. When the entry ports occur exclusively among job classifications with low content, the external labor market does not significantly affect the internal market structure. However, plants which also find it practical, in terms of training costs, to hire into skilled maintenance or operating jobs will find their ability to do so constrained by the external availability of the appropriate skills and experience. This availability is a function of the "tightness" of the external labor market in which the plant is located. When external shortages of certain types of skill exist, the entry ports for the skills will cease to function, and the required skills typically will be developed internally.[27] One automobile company, for example, activates a transfer linkage between production and maintenance departments to provide an internal training sequence for maintenance craftsmen whenever such skilled workers cannot be hired on the external market. In another case an electrical equipment manufacturer intermittently institutes an internal on-the-job training program for automatic screw machine operators in response to shortages of this skill on the external market.

Institutional Forces

Three institutional forces also impinge upon the operation of the internal labor market: custom, union organization, and managerial procedures. Because the rules have such an important impact upon the job security and opportunities for advancement of individuals within the plant, union rules and plant custom tend to inhibit attempts to change them. Similarly, the efficient operation of the plant within any given set of rules is heavily dependent upon a skilled managerial staff capable of utilizing temporary transfers to provide training opportunities for employees who will later be promoted. Economic theory normally abstracts from such institutional frictions, but it was apparent in the plant visits that these forces are too important in the behavior of the rules governing labor allocation to be neglected. The reasons for their importance are closely connected to the existence of the internal labor market itself. In creating a stable work community in which the same individuals have regular contacts with each other over a prolonger period, the internal labor market fosters the development of custom and of union organization. Moreover, the very factors that structure the internal labor market also imply that the firm's present employees can be replaced only at a cost, and so provide an incentive for the firm to accommodate the desires of the present work force. Similarly, the existence of the internal labor market also implies that the plant must perform administratively a number of market functions and requires a series of consistent procedures and a skilled staff to implement them.

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[26] Clark Kerr, "The Balkanization of Labor Markets," in E. Wight Bakke, et al., *Labor Mobility and Economic Opportunity*, (Cambridge: Technology Press of M.I.T., 1954), p. 102.

[27] Depending on the production process, it may also be possible to subcontract some of the work performed within the plant to alleviate internal skill shortages.

While these institutional forces must be counted a major factor in the development of the internal administrative rules, competitive forces clearly circumscribe the extent to which these rules can be incompatible with the economic and technical contexts in which the firm operates. If the divergence is too great, the plant will be driven out of existence. Moreover, both the literature on this subject and observations within the plants visited suggest that, while sudden discontinuities in internal rules are unusual, the rules can be changed gradually to accommodate changes in the technical and market contexts without encountering employee resistance. Thus, there appears to be a tendency, despite considerable institutional friction, for economic and technical forces to gain expression. The institutional frictions do, however, prevent the firm from using the rules as instruments of adjustment in the short run.

4. THE RELATIONSHIP BETWEEN EXTERNAL AND INTERNAL LABOR MARKETS

The typical manufacturing plant receives a flow of job applicants, even when it is not hiring. It is through variations in the size and character of both this flow and the turnover among its own employees that the plant is made aware of changes in external labor market conditions. When the market tightens, for example, the flow of applicants decreases, the average quality of applicants deteriorates, and turnover rates may rise.

The plant's hiring activities may be divided into two components: (1) efforts to regulate the flow of applicants, and (2) efforts to select employees from this flow. Regulation of the flow occurs through changes in recruitment procedures and in wage rates. With fixed external market conditions and a given level of compensation, the firm can increase applications through a series of progressively more elaborate, and more expensive, recruitment procedures. These range from calls to the publc Employment Service to newspaper advertising, arrangements with private employment agencies, rewards to present employees who recruit friends and relatives, and efforts to attract distant workers by paying transportation costs and moving expenses.[28] Alternatively, the firm can increase the stream of applicants simply by offering increased compensation.

The selection of employees from the flow of applicants is effected through hiring standards and screening procedures. The nature of the hiring job vacancies and the jobs related to them through upgrading sequences influence the characteristics that workers must possess to be hired. These characteristics relate to the employee's ability to perform a job, to acquire new skills and abilities, and to adapt to the social environment of the plant. The employer establishes hiring standards based upon these characteristics. Some criteria, such as the ability to perceive color, may be absolute in terms of job requirements while others, especially skill and ability factors, are flexible to the degree that the level of job performance does not fall to zero when they are lowered. Workers differ considerably in the speed with which they can perform the job, the amount of materials they waste in the process, the number of mistakes they make, and so on. Moreover, job performance is affected by a variety of elusive, but nonetheless real, worker traits: honesty, reliability, ability to follow directions, capacity to learn, response to supervision, and the like, which are possessed by workers in varying degrees. Thus, within the broad limits established by the job, management exercises considerable discretion over the kind of workers it is willing to hire. This discretion is further extended by the plant's training procedures.

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[28] See Richard A. Lester, *Hiring Practices and Labor Competition*, (Princeton: Princeton University Press, 1954), Industrial Relations Section Research Report No. 88, pp. 37–47 and *Adjustments to Labor Shortages*, (Princeton: Princeton University Press, 1955), Industrial Relations Section Research Report No. 91, pp. 33–37.

While the concept of a hiring standard is clear in theory, it is less so in practice. The only true measure of a worker's effectiveness is performance on the job. It is seldom feasible to assess either this performance or the worker's personal traits until some time after he has been employed. The plant therefore uses a variety of screening procedures ranging from a simple review of the worker's education and work history, as he has reported it, to increasingly elaborate (and expensive) procedures such as interviews, reference checks, and testing. As an alternative to intensified recruitment and screening procedures the plant may attempt to reduce labor turnover through changes in wage rates and modifications in its internal rules, such as relaxed disciplinary procedures.

The five variables—hiring standards, screening procedures, compensation, recruitment, and training procedures—define the relationship between the plant and the labor market. They constitute competing instruments of adjustment to changing supply and demand conditions in the labor market.[29] Together these instruments supply the plant with a number of alternative modes of adjustment. The profit-maximizing plant should seek that combination of instruments that, for given external market conditions, internal rules, and job structure, minimize adjustment costs.

The explicit recognition of these instruments provides insights into a number of different labor market problems. They should, for example, aid in the understanding of the changes in the composition of unemployment over the business cycle and the relationship between unemployment and wage behavior. For the problem of technological change, however, the instruments are of interest in two respects: (1) as determinants of labor costs they indicate labor market scarcities and enter (or in theory should enter) into decisions concerning job design, and (2) as instruments of adjustment they provide means through which the plant adapts to job changes. In both respects the variables are subject to certain limitations.

The Effect of the Internal Labor Market

In principle the list of hiring variables characterizes the process of filling any plant job. In the plants visited, however, the rules governing internal allocation curtailed—and in some cases completely removed—management's ability to change these variables when jobs were filled internally. Rules or customs governing the posting of job vacancies, and "seniority and ability" clauses setting standards and screening procedures for promotion, for example, like seniority districts themselves, are subject only to gradual change and could seldom be utilized for short-run adjustments to market conditions.

While rules defining the internal labor market do not directly establish hiring procedures, they do exert considerable influence upon the context in which the firm's hiring decisions are made. For example, to make effective the priorities accorded employees already within the plant, contract or custom generally restricts management's right to discharge workers for misconduct or substandard performance after a short probationary period. Such a restriction upon discharge raises the cost of relaxing hiring standards and screening procedures and discourages experimentation in these areas. Similarly, the employment guarantees in the internal labor market make hiring standards for entry jobs dependent upon the requirements of the jobs to which the worker may later be promoted and frequently of jobs that do not yet exist.

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[29] Under certain circumstances, however, these instrumenst are clearly complementary. If the firm reduces hiring standards progressively, for example, it will eventually be forced to engage in additional training. In other circumstances, a given procedure will serve more than one purpose: incentives to present employees to recruit relatives and friends act as a screening device, tending to insure that new hires will come from a background similar to that of workers already within the plant.

Wage Determination at the Plant Level

Although a complete discussion of the functions of the wage rate in the internal labor market is beyond the scope of this report, several facets of the inplant wage determination process are crucial to the understanding of plant adjustments to labor market conditions and technological change.

1.) The wage rates on individual jobs within the plant are usually set through a series of procedures such as job evaluation plans, time-study techniques and other less formal arrangements that involve studying a job as it is being performed. Such procedures render it difficult for equipment designers to estimate the wage rates and manning requirements on a new job before it is in operation.

2.) The wage rates for the various jobs within a plant are linked together through job evaluation comparisons and through custom. It is difficult to rearrange the order of wage rates, and even the differentials within the wage structure can be varied only within narrow limits. This makes it relatively expensive for the firm to use wage rates as an instrument of adjustment to market scarcities for, in raising wages of those job classifications for which labor is scarce, it runs the danger of exerting upward leverage upon the entire wage structure. This provides an incentive to rely more heavily upon other instruments of adjustment.

3.) An additional incentive to rely upon nonwage instruments is the concern about inducing a wage spiral in the community, as plants tend to adjust their wage rates to each other within a labor market.

4.) Wage rates in the plant are attached to job classifications rather than to individuals. "Payment-by-results" plans and merit-rate ranges permit some wage differentiation among workers holding the same job, but these procedures are designed primarily as work incentives rather than to equalize the costs of employees of differing productivity. Hence, the costs of training procedures and reduced hiring standards, experienced through reduced productivity, must be borne by the plant.

The Effect of Indirect Costs

The third factor affecting the usefulness of the discretionary adjustment instruments and their function as indicators of labor scarcities is the difficulty of identifying their costs and of allocating them to specific labor grades. The costs of variations in hiring standards are perhaps the most difficult to estimate. Reduced hiring standards are reflected in lower labor productivity, equipment downtime, repair costs, waste of materials, high costs for supervision, and (to the extent that absenteeism increases) a larger labor force. The costs are, in other words, indirect and spread over a number of variables. Estimation is complicated by many other factors that impinge upon these variables, making it difficult to identify the influence of hiring standards. Experiments that might make it possible to separate the influence of hiring standards are inhibited by the rules and customs restricting management's freedom to discharge workers once they have entered the plant and passed probation. Cost estimation is further complicated if consideration is given to senority in promotion. Hiring standards will then affect the costs not only of the job for which the worker is hired, but also the costs of other jobs to which he may later be promoted. It is not impossible to estimate these costs, but it is exceedingly difficult to do so, and no plant in the study had any but a vague, qualitative notion of what the effects of lowered hiring standards would be.

An attempt to estimate the costs of training encounters similar problems. Only where training takes place in formal classroom programs can its costs be readily identified. Much training, however, takes place on the job, and its costs, like those of reduced hiring standards, are reflected indirectly in machine downtime, wasted materials, increased supervision, and the like. Indeed, in many respects the period of on-the-job training can be viewed as one of temporarily reduced hiring standards.

Unlike the cost of training procedures, the cost of the actual screening process, of interviewing, testing, and the like, is a direct cost and in most plants appeared explicitly in the budget of the personnel department. Screening procedures, however, are almost never entirely successful. They usually rely upon surrogates for the qualities they are trying to measure: physical "appearance" in an interview is used to gage honesty and reliability on the job, standard test scores to predict job performance, eighth-grade education as presumptive evidence of literacy, and so on.[30] Because the plant relies upon surrogate measures, there are positive risks of failure. These risks are of two types (analogous to type I and type II errors in the testing of statistical hypotheses): the risk of accepting an unqualified candidate, and the risk of rejecting a qualified candidate. Both risks carry costs. The costs of accepting an unqualified candidate are those of lowered hiring standards, and alternatively, of the increased labor turnover that results when an unsatisfactory worker must be discharged. The costs of rejecting a qualified candidate are those of maintaining a larger candidate group through increased recruiting efforts and higher compensation. Thus screening procedures have indirect as well as direct costs.

Among the instruments of adjustment it appears that only compensation and recruitment are readily measurable. Even these variables, however, present difficulties. The costs of some nonwage compensation—pensions, vacations, and the like—and many recruiting activities can only be estimated with a wide margin of error.

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[30] Cf. National Manpower Council, *A Policy for Skilled Manpower*, (New York: Columbia University Press, 1964), pp. 97–105.

5. THE INTERNAL JOB STRUCTURE AND TECHNOLOGICAL CHANGE

Simon Kuznets has defined an industry by its material, process, and product.[31] These factors may characterize a plant as well and they determine the work it does. Within a plant, work is divided into a series of tasks each of which is assigned to equipment, to labor, or to a combination of both. When work is assigned to equipment, new tasks are created in connection with the operation, maintenance, and repair of the equipment. When it is assigned to labor, an analogous group of subsidiary tasks is created by the need for supervision and maintenance of the labor force. A job is a group of tasks, taken from the total of those assigned to labor, performed by an individual employee.[32]

Understood in these terms, job generation on the plant level is a three-part process: 1) the selection of an industry, 2) the selection of the equipment, and 3) the combination of the labor tasks, defined by the industry and the equipment, into jobs.[33] In the plants visited for the present study, the industry had already been selected. This chapter concentrates, therefore, on the process of selection of capital equipment and design of jobs, and the responsiveness of the process as a variable of labor market adjustment. Modifications in the product were investigated in plants that produce capital equipment since product changes in these plants are an integral part of innovation in the equipment of their customers. Relatively little material was gathered, however, concerning the effect of changes in product upon the plant's own jobs.

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[31] Simon Kuznets, *Economic Change*, (New York: W. W. Norton and Co., 1953), p. 145. More conventionally, an industry is defined by the product. However, in the study of technological change, such a definition frequently yields ambiguous results. It fails to distinguish, for example, between the cotton and woolen textile industries, each of which has had a different technological history. The addition of "raw materials" to the definition solves this problem. "Process" is added to the definition to distinguish between industries like cast iron and wrought iron, which also have had divergent technological histories but produce essentially the same product with the same raw materials. The inclusion of the "process" creates the danger that a technological change in the method of production will be confused with changes in the industry in which the plant is located. Such ambiguity, however, is minimal in this study, which is primarily concerned with changes in the distribution of work between labor and equipment, and among different types of labor.

[32] This definition of a "job" is derived, with some modifications, from Louis L. Davis and Ralph R. Carter, "Job Design," *The Journal of Industrial Engineering*, Vol. VI, No. 1, 1955 p. 3.

[33] If the geographic characteristics of jobs had not been excluded from the study, the decisions concerning plant location would constitute a fourth part of the process of job generation.

The Selection of New Capital Equipment

Any and all parts of the process by which capital equipment is selected can be performed internally within the enterprise or externally by specialized engineering firms and vendors of capital equipment. The material in this section pertains directly to large multiplant corporations that were able to develop innovations without external aid. Even in these firms, however, the alternative of having innovations developed externally was usually available. The selection of capital equipment was therefore governed by much the same set of forces, whether it took place within the firm or outside of it, and the material presented in this section constitutes a basic model of capital equipment selection. The participation of outside institutions is discussed in Section III as a variant of that model.

The Search for Innovational Areas

In large corporations, the search—that is, the identification of points in the production process at which innovations might be made—is conducted largely by operating personnel attached to specific manufacturing processes.

In the strictest sense, the operating personnel include both line management and production and maintenance employees. The interviews, however, yielded little information about innovations originated by production and maintenance workers. Such innovations usually are made informally, and often surreptitiously. Frequently, innovations by production workers are designed to increase the yield where incentive systems are in effect and they are not reported to management for fear that production standards will be revised.[34] Innovations by repair crews are fostered by pressure to reduce equipment downtime. Since they involve short cuts in standard repair procedures, they too are hidden from management. One striking example encountered during the visits to plants was the repair of a food-processing machine, in violation of health standards, with adhesive tape and rubber bands.

Informal innovations by hourly workers may account for a significant portion of increases in productivity.[35] It is unlikely, however, that they are governed by the labor market.[36] Indeed, they would seem to inhibit the plant's responsiveness to market forces. Since only the worker who developed these innovations fully understands them, he cannot, therefore, be replaced without a sacrifice.

Formal innovations by hourly workers in the plants surveyed were unusual. While nearly all of the plants formally solicited suggestions from hourly workers, no innovations were credited to this source during the interviews.[37]

Most of the innovations cited during the interviews had been originated by personnel classified as line management: foremen, and other supervisors, and engineers assigned to operating departments. For these people, the development of modifications in productive techniques constitutes a part of their operating responsibility necessary to insure the smooth and continual operation of the manufacturing process.[38] Line management, particularly the engineers, was also expected to produce cost-saving ideas.[39]

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[34] See, for example, Stanley B. Mathewson, *Restriction of Output Among Unorganized Workers*, (New York: Viking Press, 1931), pp. 110–114.

[35] Such minor innovations by production and maintenance workers undoubtedly constitute one of the sources of the "Horndall effect." This phenomenon was named by E. Lundberg after the Horndall iron workers in Sweden, where the output per man-hour rose 2 percent per year over a 15-year period in which there was no new investment. E. Lundberg, *Produk-Livitctoch reatabilitet*, P. A. Norstedt and Soner, 1961, cited in Kenneth J. Arrow, "The Economic Implications of Learning by Doing," *The Review of Economic Studies*, Vol. XXIX (13), No. 80, 1962, p. 156.

Arrow attributes the Horndall effect to "learning by doing." As he uses these terms, they appear to embrace innovations developed by production workers under the stimulus of the work process. Another source of the Horndall effect is learning in the more conventional sense. It will be seen that in practice it is very difficult to separate training from minor innovations, for many of these innovations are stimulated by the training situation and are designed to facilitate the training process.

[36] Job skills are frequently transferred by the incumbent to his replacement orally and by demonstration on the job. In this process, the job itself is occasionally altered in one way or another. Sometimes these alterations are temporary and are dropped once the initially inexperienced replacement becomes more adept at the work. But they are occasionally permanent changes. They represent a form of accommodation to changes in the quality of the labor supply available. They frequently involve no changes in the equipment, but when they do, these are usually developed with the knowledge of the supervisor.

[37] In some plants, formal suggestions are important. See George P. Schultz, "Worker Participation in Production Problems," in Frederick G. Lesieur (ed.), *The Scanton Plan*, (New York: The Technology Press of M.I.T. and John Wiley and Sons, 1958) pp. 34–50. See also Sumner H. Slichter, James J. Healy and E. Robert Livernash, *The Impact of Collective Bargaining on Management*, (Washington: The Brookings Institution, 1960), pp. 355-361.

The personnel of a series of nonoperating departments located at the corporate level and, in large plants, at the plant level as well, were responsible for working out projects that the operating personnel did not have the time or resources to pursue. Thus they played a major role in the design of new equipment. In the search, however, they acted primarily as consultants to the operating personnel, and did not play an independent part.[40]

Two factors appear to explain the key role that operating personnel play in the search for innovations. First, it is easier to fix responsibility in operating units, and they are thus more easily controlled. They can be judged directly in terms of cost performance, making it unnecessary to determine the exact cost-saving of particular innovations. Nonoperating units are more difficult to manage since the criteria for judging their success and for determining their optimal size are less obvious. Several companies in the sample had developed elaborate schemes for doing this, but none of them appeared to be entirely satisfactory, even to the companies involved.

The second factor explaining the key role of operating personnel is the nature of manufacturing technology. Since this point is central to an understanding of the whole process of technological change, it is developed below at some length.

Laymen tend to believe that manufacturing technology is firmly based upon scientific theory and engineering design. In fact, however, many manufacturing innovations are developed experimentally. The classic example of this phenomenon is the development of coking for coal in 18th century iron manufacture,[41] but innovations in manufacturing technology continue to originate in this way. The fact that they do does not necessarily mean they cannot be explained scientifically. It often indicates only that the scientific problems involved are too specialized or too trival to command theoretical interest, or that the engineer feels that an empirical solution is more expedient.[42] As an engineer engaged in designing an atomic power plant commented, "If we completely designed the plant before we constructed it, we would never start building."

Moreover, even equipment initially built to formal specifications is subject to a variety of modifications, few of them formally recorded, once it has been put into operation. Hourly employees are responsible for some of these modifications. Others are developed by line supervisors and by engineers, but are thought to be too minor to require formal description. Such changes accumulate over time, and the equipment moves a considerable distance away from its original design. Frequently that design is lost.

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[38] See Charles R. Walker, Robert H. Guest, and Arthur M. Turner, *The Foreman on the Assembly Line*, (Cambridge: Harvard University Press, 1956), *passim*, but especially pp. 106–108.

[39] The nature of the payment system has some effect upon the source of innovations. When there is no incentive payment system, and work effort is either enforced by a system of measured day work, or by the pace of a moving assembly line, the supervision assumes a greater responsibility for insuring output. Many of the innovations made by production workers to increase yields where incentive systems are in effect are made, where there is no incentive plan, either by the supervisor himself or with his cooperation. The division of labor between the supervisor and production workers is not a function solely of the payment system. It is also a function of the technology: on integrated assembly lines a change in one job is likely to require adjustments at neighboring work stations. Thus, the innovations which can be made in a single operation without the help of the supervisor are limited. However, the impact of the payment system upon the job of supervision is apparently grave enough so that several plants felt unable to move either production workers or supervisory personnel from one system to another. Adjustments in the production process which gave rise to innovation were among the explanations offered.

[40] An exception to this generalization was found in one corporation in which teams of engineers from corporate engineering departments periodically toured company plants looking for areas of innovation. This arrangement, however, did not seem to change the basic character of the search; the touring engineers spent most of their time looking at processes to which operating personnel had called their attention.

[41] Cf. Thomas S Ashton, *Iron and Steel in the Industrial Revolution*, (Manchester: Manchester University, 1924), pp. 24–59.

[42] Cf. Abbott Payson Usher, *A History of Mechanical Inventions*, (New York: McGraw Hill, 1929), pp. 8–31, and Irving H. Siegel, "Scientific Discovery and the Rate of Invention," in National Bureau of Economic Research, *The Rate and Direction of Inventive Activity: Economic and Social Factors*, (Princeton: Princeton University Press, 1962), pp. 441–450.

Because manufacturing technology tends to rest upon an empirical base, attempts to improve it typically begin with a study of the process in operation on the plan floor. This appeared to be true of both chemical and mechanical processes. One chemical engineer commented: "I spent two weeks in the plant trying to separate the essentials of the process from what was basically witch craft. I know I didn't completely succeed, but I was afraid to go further. And they told me that process was automated!" In another plant, the engineers had rejected a proposal to move a complex piece of mechanical packaging equipment 2 feet across the plant floor because they were afraid that they would never get it operating again at maximum speed.

In the conduct of the search, this basic empiricism places the operating personnel in a pivotal position. They alone understand the process sufficiently to evaluate its potential for improvement. Outsiders from the nonoperating divisions of the corporation might develop this understanding, but only over a period of time, and it is never clear in advance whether the improvements they might effect would justify this time. It is thus more economical for the operating personnel to choose projects in which they think innovations are possible and then call in the nonoperating divisions if they consider it warranted.

Insofar as the search is conducted by the operating personnel, it appears to be largely independent of labor market forces. Many innovations are designed to overcome specific operating difficulties: an equipment breakdown, a deterioration in the quality of the product, changes in the quality of raw material inputs, labor relations problems, and the like. Operating difficulties are subject to a number of random influences, but they seem to cluster around both very old and very new equipment. Old equipment breaks down frequently, while new equipment often has mechanical difficulties until the " bugs " are worked out. New equipment tends also to disrupt processes that are physically related to it. In the plants studied, this last effect was a particularly important stimulus to technological change. A number of innovations were designed specifically to improve the speed and accuracy of processes that fed material into new machines or received output from them.[43]

The labor market was responsible for only one class of operating difficulties: those created by workers who could not readily acquire requisite operating or maintenance skills. Most plant personnel reported, however, that they rarely tried to solve these difficulties by technological innovations or other forms of job redesign. Innovations were attempted only as a last resort, after the personnel department had made an effort to solve the problem by changing hiring standards or screening procedures as described previously.

In addition to developing innovations designed specifically to overcome operating difficulties, the line management, especially engineering personnel, was expected to develop ideas for reducing production costs. The engineers, at least, did so. They spent what several called their "spare time"—time not devoted to operating problems—investigating other areas for potential innovations. These appeared to have been selected in two ways. First, the engineers simply spotted points in the productive process where innovation seemed possible while moving around the plant on other business. This suggests that innovations are most likely to occur in areas where there are operating difficulties, for the engineers will spend enough time observing them to gage their potentialities for improvement. Thus, even innovations not directly stimulated by operating difficulties tend to take place in physical proximity to them, and to be governed by their distribution.

The second source of ideas for potential innovation is the background of line management. All of the engineers and, increasingly, line supervisors as well, are college graduates. Since they are usually assigned to an operating division at the beginning of their careers, in preparation for higher posts in nonoperating divisions, their educational background is recently acquired and hence tends to include the most advanced technical training. Their formal education is supplemented by an empirical understanding of technology gained during work in the operating divisions. Companies make deliberate efforts to broaden this understanding. The desire to do so is one of the reasons for frequent transfers of managerial personnel. Some large corporations also organize interplant tours for departmental foremen and engineers, and in certain industries (the automobile industry is an example) interfirm visits are common.[44] In addition, plants encourage line engineers to meet with the sales representatives of equipment vendors and to attend equipment exhibitions and trade fairs. Finally, the engineers themselves make it a point to keep abreast of developments in their field by reading trade magazines, equipment catalogs, and, infrequently, theoretical literature.

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[43] Kuznets notes this effect in explaining the rate of technological advance within an *industry*. "Technically, a branch of production is a series of separate operations that lead to an invariable sequence from the raw material to the finished product. Once an important process in this chain is revolutionized by an invention, pressure is exerted upon other links of the chain to become more efficient. Any disparity in performance at the different stages precludes full exploitation of the innovation made." Kuznets, op. cit., p. 267.

These media through which the engineers' technical background is developed and maintained constitute the major links between the plant and the technology that prevails in society at large. They serve to direct the search for innovations toward areas in the plant where principles and techniques embodied in new equipment developed elsewhere might be exploited. This, in turn, creates a tendency for technology throughout the economy to cluster around related technical principles. Moreover, though the media do not directly strengthen the influence of the labor market over the selection of areas for innovation, they tend to spread whatever influence the labor market does exert, whether over the search or over the design and installation of new equipment.

The fact that scholarly journals are of secondary importance among the media used by engineers is also suggestive of the forces that govern technological change. Although trade magazines were much in evidence in engineering offices, scholarly journals were seldom seen. Several of the engineers who did have such journals on their bookshelves were characterized as slightly peculiar by their colleagues, and themselves tended to discuss their interest in the journals as if it were an avocation rather than an adjunct to their profession.

This attitude springs in part from the dominance of the empirical approach in engineering, which was discussed above. Engineers mentioned two additional factors. First, feasibility is of major importance in the selection of areas for innovation. Because they report technologies that are in operation, trade magazines, salesmen, and the like, provide an assurance of feasibility, which more abstract, theoretical literature often does not. Second, innovations derived from existing technology are more economical to build in that standard, mass-produced components whose technical problems have already been worked out can be used. When respondents were asked during the interviews why innovations currently being developed or introduced had not been attempted earlier, their most frequent reply was that the standard components used in their construction had not been available earlier. In some cases they said that the innovation had been *technically* feasible for some time.

These comments suggest that the clustering of technology is produced, fundamentally, by economies of scale in the design and production of capital equipment. They also suggest that the dynamic element governing the pace of technological change in any particular industry is not the cost of labor but of capital.[45] Rising labor costs in the society as a whole may partially determine the level of technology at which the economies of scale are realized (and at which the clustering takes place). But an increase in labor costs in a single plant or industry will have relatively little influence. If this is true, individual labor markets and wage structures will also exert relatively little influence upon the pace and direction of technological change, and the likelihood of structural bottlenecks will be increased.[46]

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[44] James R. Bright, *Automation and Management*, (Boston: Harvard Business School, Division of Research, 1958), p. 91.

[45] See W. E. G. Salter, *Productivity and Technological Change*. (Cambridge: Cambridge University Press, 1960), p. 44 and Paul A. Samuelson, "A Theory of Induced Innovation Along Kennedy-Weisacker Lines," *The Review of Economics and Statistics*, Vol. XLVII, No. 4, November 1965, p. 355.

[46] This suggests also that, except where specific technical alternatives have already been developed, there is little incentive for any particular union to moderate its wage demands in the expectation that it will thereby stave off labor-displacing technology.

To exert even a generalized influence, however, labor costs must at some point enter into technological decisions. As we have seen, they are given little weight in the search for innovations. It will become apparent in the next section that they play a greater role in the design of equipment. Before turning to that problem, however, it is necessary to explore one final influence upon search activities, the cost controls imposed upon production departments by corporate management. All the plants studied operated under some system of cost control. In light of the several hypotheses about the impact of relative factor costs upon the direction of innovative activity, these systems were discussed at length during interviews. The interviews yielded two kinds of information useful in evaluating the influence of cost controls: information about the mechanical properties of the systems in focusing attention upon certain specific areas of the plant and the engineers' assessments of the effect of the systems upon their own behavior.

The basic approach to cost control in the plants studied was to divide total production cost into a series of components and then compare each component to a standard or "bogey." Higher management investigates a component when it exceeds its standard.

In assessing mechanical properties of the controls, three features are of interest:1) the components into which total costs are divided, 2) the standards to which costs were compared, and 3) management's reaction where costs exceed the standard.

In general, total cost was divided first by department, frequently divided again by subdepartment, and finally divided by factor input. The broad input definitions of economic theory were not employed. Material costs were broken down according to type of material, and labor costs separated into production, maintenance, and supervision, occasionally with finer divisions.

The bogeys to which actual costs were compared were derived from either engineering standards or historical data. A number of plants also built a cost reduction target into them. These targets were derived in a variety of ways. Two plants based them upon historical trends: in the first, the trend rate of cost reduction for the plant as a whole was applied to the bogey for each cost component; in the second plant, figures were derived for each component separately from the component's own trend rate. Another firm appeared to base its target upon the savings in costs required if the plant was to maintain its competitive position. In a fourth plant, top management constructed a plant-wide target based on its competitive position, but negotiated adjustments with the departmental engineers when applying the overall target to set departmental standards. Several other plants used analogous forms of negotiation between various levels of management.

Management's reaction when costs exceeded standards did not fall into a readily discernible pattern. When asked whether a wage increase would increase the pressure to reduce labor costs, some respondents replied, "Yes, definitely," while others foresaw no effect at all. In several plants, answers to this question were inconsistent. And even when particular wage increases were discussed, the inconsistencies remained. Confronted with them, one respondent suggested that top management was simply capricious.

The cost controls were clearly administered with a considerable degree of flexibility, and management's application of them appeared to depend upon the profit position of the plant and the reputation of the person who was responsible for the component in question.

The diversity of cost control systems makes it difficult to generalize about their mechanical properties. A thorough analysis would require detailed investigation of the cost structure of each plant, as revealed by its own cost control system, and this was not feasible in the present study. Such analysis as the material permits suggests that the weight of a given input in total cost does not influence the character of the search for innovations. Where each cost component is compared to its own standard, the weight of an input in total cost is not identified. On the other hand, where the cost control system calls for application of a single cost reduction target to all components, differential rates of change in factor costs, arising either from differences in the rate of price changes or from savings resulting from previous innovations, may have some influence. In plants employing this procedure, however, it was reported that higher management generally accepted price changes as an adequate explanation for failure to meet the target reduction.

The other material gathered in the interviews suggested that the mechanical properties of the systems are of decidedly secondary importance. In all plants, the engineers reported that the systems had very little impact on their own search activity. They exerted a generalized pressure for cost reduction, but had little influence upon the direction in which the reduction was sought. Several features of the systems tend to confirm these reports. The procedure in several companies of setting cost reduction targets in the light of the plant's competitive position suggests that it is general cost reductions rather than specific innovations that are being sought. The diversity of procedures used in the plants visited would seem to imply that management is unsure how best to conduct the search. That cost controls do not shape the character of the search is further indicated by the willingness of some managements to negotiate cost targets with the engineers. Of course, the search is seldom a blind expedition into the technological unknown, and operating personnel have very definite ideas as to the direction in which it is likely to be most fruitful, while higher management, removed from the specific context in which the improvements must take place, does not. The best that corporate management can do, therefore, is to put pressure on the operating personnel to act on their ideas.

In summary, the search for areas of potential innovation appears to be conducted largely by personnel attached to specific manufacturing processes and is directed first toward the solution of operating difficulties. Other areas for innovation are spotted by the operating personnel in their travels on the plant floor or suggested by exhibitions of equipment, trade magazines, and other media, which provide information about processes that are technically feasible and about technologies that have been introduced elsewhere. These media tend to extend whatever influence the labor market exerts over the innovation process. But except when certain labor scarcities result in operating difficulties, the search for innovation is apparently independent of direct labor market influence.

A more deliberate pressure for innovation is exerted from outside the operating divisions of the plant by corporate cost control systems that are various and far from uniform in their impact. It appears that their major effect is to increase the pressure upon operating personnel to search for costsaving innovations. They seem to have little effect on the direction in which that search takes place.

The Design Process

There was not always a clear dividing line between the selection of areas for potential innovation and the actual design and installation of the innovation in these areas. In the case of minor modifications, recognition of the possibility of change was often synonymous with its realization. The innovation was designed and constructed on the floor by the operating personnel to whom it first occurred, often by the operator himself. In such cases, the design process took place within the head of the innovator. If choices were made between alternative designs, they were made intuitively, often subconsciously. To the innovator, and certainly to the observer, the design process appeared to be purely technical, allowing little scope for relative wage rates or other indicators of market scarcity to exert an influence.

However, when the search indicated a need for innovations, the exact nature of which was not immediately clear, or when radical departures from existing technology seemed to be needed, a separate, identifiable designing process took place. The operating personnel who selected a production problem for solution consulted with the plant or corporate engineering staffs, turning the whole problem over to them if the project was large or complex. Once the project fell within the province of the nonoperating engineering departments, it was typically subject to a preliminary feasibility study to determine whether an innovation was technically possible and, if possible, whether the returns were likely to warrant the costs of design and construction. Two or three additional comprehensive and formal reviews were conducted before a design was approved for construction. The level of management at which these reviews occurred varied with the magnitude of the project. Approval of the board of directors was often required for very large projects.[47]

The corporate engineering departments typically included product engineering, manufacturing (or process) engineering, and industrial engineering. Allocation among these departments of responsibility for particular projects depended upon the nature of the project. Innovations in manufacturing equipment were assigned to manufacturing engineers; innovations in the arrangement of the equipment on the floor, and in its manning requirements, to industrial engineers. Designs were usually sent to other departments for periodic review, however, so that they could assess the effects upon their areas of competence. Very large innovations involving major changes in each of the engineering areas were often designed by teams whose members were drawn from all three departments.[48]

Because the designs had to be carefully costed and presented for approval, it was usually possible to identify the various decisions made in the course of design development and the factors that affected these decisions. In fact, since the engineers frequently worked in teams and prepared to justify their work to each other, they were often able to identify and explain decisions which involved no explicit cost calculation. On the whole, respondents were far more articulate about and interested in equipment design procedures than any other area explored in the interviews. They spoke freely and frequently covered material not directly solicited by questions. Their comments suggested that the influence of the labor market upon design decisions should be examined on three levels: 1) the weight of economic variables relative to purely technical considerations, 2) the consideration of substitutions between labor and other factors of production, and 3) the consideration of substitutions between different types of labor.

Technical versus economic considerations in design. The specific aspect of the design problem that most intrigued engineers was the role of economic factors relative to the purely technical aspects of design. It was extremely difficult to direct their attention away from this question to others relating to the role of the labor market. All of the engineers interviewed were greatly concerned about what they regarded as the mistaken tendency of their profession to give technical virtuosity priority over economic efficiency. They maintained that it was a constant struggle to try to overcome this tendency. Each felt that he had succeeded, but made unflattering comments about engineers in other countries (particularly Germany), other industries, and occasionally other corporations in his own industry and departments within his own corporation.

The system of rewards and incentives for engineers certainly should serve to curb the tendency to give priority to technical perfection. An engineer's career within the corporation depends upon the economic contribution his projects make to the enterprise. In most corporations, a system of bonuses based upon cost savings ties the engineer's immediate income to his projects as well. Moreover, the engineer's professional pride, which is the basis of his interest in technical perfection, also generates a desire to see his designs constructed and operating, and design approval is heavily dependent on cost minimization. These incentives, however, tend to be discrete rather than continuous. When the cost savings are already large and project approval has been assured, the engineer has more leeway to strive for technical perfection. Moreover, cost pressures upon product engineers are probably less than those upon manufacturing and industrial engineers. The financial contribution of product improvements is more difficult to assess in advance than is the contribution of improvements in equipment, since they do not usually generate cost savings. Their success depends upon the reaction of consumers and the behavior of the plant's competitors. It is frequently possible to argue that improvements in the quality of the product will increase its market, and such quality improvements are generally synonymous with the engineer's realization of his concept of technical perfection. Thus, while economic considerations do play a very important role in engineering design, the engineers probably tended to exaggerate their influence.

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[47] These procedures generally followed those described by Walter W. Heller, "The Anatomy of Investment Decisions," *Harvard Business Review*, Vol. XXIV No. 2 (1951) p. 99. See also Bright, op. cit., pp. 88–106.

[48] See Bright op. cit., pp. 88–106.

Substitutions between labor and other factors of production. In moving from costs in general to those specifically imposed by the labor market, a clear distinction in practice emerged between the cost of labor taken as a homogeneous factor and the cost of various grades or types of labor. The concept of substituting capital equipment or raw material wastage for labor factors proved to be a very meaingful one to the engineers. In evaluating projects, they costed out the labor input not only for the total project but also for alternative designs, unless the relative cost advantage was obvious. But in doing so, they tended to neglect the distinctions between skill levels of labor and to treat it as a homogeneous factor of production.

The costing procedure was based upon a three-part calculus: an estimate of the annual operating cost of the design; an estimate of its annual output (or productivity); and an estimate of its capital cost. The labor input affects both the estimated operating cost and the estimated annual output.

The operating costs of the design were generally computed on the basis of a figure for average unit labor cost. The figure appeared to be a convention used throughout the engineering departments, but its source was surprisingly difficult to trace. In only one plant was the source identified, and there the figure had been developed by the personnel department using the wage and fringe benefit costs for production and maintenance labor, corrected by the addition of the budget of the personnel department so that the costs of hiring, training, and labor turnover would be included. (The indirect costs of these variables were not introduced by the correction. They were reflected to some extent, however, in the estimated annual output.) The personnel department revised the figure after each wage increase, but did not do so in direct response to variations in labor market conditions. No allowance was made for future wage changes.

It must be emphasized that a detailed examination of the estimated unit labor cost used in evaluating designs was possible in only one plant. Elsewhere the estimate seemed to include the costs of wages and fringe benefits, but engineers did not know whether it reflected other components of labor costs. Irregular variations in the figure suggested that it was responsive to scheduled wage changes. The one firm in the sample that did customer engineering used a wage estimate derived directly from the customer.

In the remainder of the firms, product engineers used the same estimated labor cost for all projects; they were of the opinion that the figure was probably an average for all customer plants. All of the engineers thought that the labor cost figure with which they were working made no allowance for future wage changes.

In general, there seemed to be a very definite bias in favor of the substitution of capital for labor whatever the results of the cost calculation. As one engineer put it, "If we were close, I would mechanize the operation anyway." Curiously enough, this bias arose not from anticipation of increases in labor costs, but rather from the firm conviction, expressed in every case independently of questioning, that labor was less reliable and therefore more costly than machinery. Engineers justified this conviction on two grounds. First, they pointed out that machinery is not subject to the human failings of variability and error. It works at a constant speed through the day and produces a product of uniform quality. Second, the engineers were all critical of the work ethic of hourly labor. They thought that the hourly worker generally tried to avoid work and to create obstacles to efficiency. Most engineers had some operating experience and referred to it to buttress their conviction. A general distrust and annoyance with hourly labor pervaded all levels of management in the plants studied. Thus, the bias of the engineers clearly struck a responsive cord and was apparently considered a valid criterion for decisions concerning designs at the higher levels where these decisions were reviewed. In the nonengineering departments, however, this distrust was generally expressed less vehemently and it was usually explained in terms of specific work rules or the threat of strikes.[49]

The engineer's bias in favor of labor-saving innovations is apparently a static factor involving, in effect, the addition of a fixed percentage to the labor cost figure used in their calculations. However, it may undergo changes if a union enters the plant, for example, or the union leadership becomes more intransigent. The engineers' bias may increase as the labor market tightens, for part of their stated objections to labor involve worker traits that become more prevalent when hiring standards are reduced and the plant hires either less experienced or inherently less qualified workers. To the extent that this occurs, labor market conditions exert an influence, although a delayed one, upon technological design. The bias is apparently acquired in the operating divisions of the corporation, and it takes some time for engineers in these divisions to move into the nonoperating engineering departments where designs are costed out. The labor-saving bias of many engineers interviewed during this study was still colored by their experience with the reduced hiring standards that prevailed during World War II and the Korean War.

In addition to its impact upon operating costs, the labor input exerts an influence over equipment design through its impact upon productivity. The procedures used to estimate productivity were even more difficult to fathom than those used to estimate unit labor costs. Insofar as productivity depended upon the worker, it was estimated by the industrial engineer apparently on the basis of standard time and motion studies. Where it was included at all, allowance for a learning period was estimated by reference to standard learning curves for similar jobs. There was no evidence that productivity estimates were altered to take into account the particular hiring standards prevailing at the time or likely to prevail in the future. Consequently, while some of the indirect costs of training labor influenced the design, the indirect costs of variations in hiring standards and in screening and training procedures did not appear to do so.

It is conceivable that alterations in hiring standards received little or no attention because, at the time of the interviews (October 1964 - November 1965), labor markets were relatively loose, and the plants were able to hire workers capable of producing at rates very close to engineering standards. However, maintenance skills were in short supply in a number of plants and plants exhibited no more care in estimating maintenance requirements than in estimating the requirements for other types of labor. In fact, the cost of maintenance personnel was frequently neglected altogether, and maintenance requirements were introduced into the evaluation of new design only through estimates of the amount of output that would be lost because of machine downtime. Such estimates were based on the length of time it would take a skilled craftsman familiar with the machine to repair it. They did not allow for the less efficient performance of the relatively inexperienced workmen many plants were using at the time.

Substitutions between different types of labor. In examination of the specific problem of structural balance in the labor market, substitutions of capital for labor are of less interest than substitutions among different types or classes of labor. The engineers interviewed clearly considered the former; it was less apparent that they gave explicit consideration to the latter. In about half of the plants studied,[50] a simple average of hourly wage rates was used in calculating labor costs throughout the designing process; specific jobs were never individually costed out. In the remaining plants jobs were costed individually only relatively late in the design process. The comments of the engineers gave the distinct impression, which several engineers explicitly confirmed, that detailed costing for specific grades of labor input was not done until the project proposal was being prepared for final approval, and that it did not play a role in the actual designing process.

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[49] See Thorstein Veblen's distinction between the industrial and pecuniary employment (or aptitude) and among those in industrial employment between the attitudes of workmen and engineers in *The Theory of the Leisure Class*, (New York: B. W. Huebsch, 1912), pp. 229–234; and *The Engineers and the Price System*, (New York: B. W. Huebsch, 1921), pp-52-82. Also see Perlman's discussion of the economic philosophies of manual laborers and businessmen in Selig Perlman. *A Theory of the Labor Movement*, (New York: Augustus M, Kelly, 1949), pp. 237–245.

[50] In several plants conflicting replies were received to questions designed to elicit this information. The conflicts were attributed in the interviews to differences in the size of the project, but they also appeared to be related to the time available for making estimates, and to differences in the degree of confidence which higher management placed either in the individual engineer or in the project he was working on.

There were several apparent exceptions to this generalization but on closer examination they proved to be consistent with it. Two corporations were in the process of moving plants to new locations at the time they were visited, and both had attempted to forecast the costs of training the new labor force they would need. Only one, however, had broken down these costs by individual job categories, and its personnel department, which was responsible for carrying out the training program, was developing a new program without reference to the engineer's training plans. Another case where the cost of a specific type of labor appeared to exert a direct influence in the selection of technology was the substitution of solid state for electronic controls in numerically controlled machine tools. Several informants in trade associations attributed this substitution to the scarcity of repair craftsmen trained in electronics. Engineers, however, always discussed the substitution in terms of machine downtime, suggesting that it was primarily a capital saving innovation. The cost of maintenance craftsmen did not appear to enter into calculations.

There appear to be two explanations for the engineers' disregard of the possibilities for substitution among labor grades. The explanation they gave most often was that the savings gained from alternative manning arrangements were so small relative to the rates of return upon investment required for project approval that attention to them was unlikely to affect the fate of the project. Under these circumstances, then, time was better spent on other aspects of the design.

Because this explanation rests upon a technical engineering judgment, it is impossible to evaluate it completely. But it does have a certain plausibility. The rates of return on investment required for project approval were extremely high, generally falling within a range of 30 to 50 percent, and even higher rates were not uncommon.[51] At the same time, the cost differentials between different labor grades introduced by the wage structure were narrowed in a number of plants by certain fringe benefit costs which are the same for each employee regardless of his labor grade. Differentials were further reduced by the costs of supervision and of recruitment, screening, and training. These costs, it is true, varied somewhat with the type of labor, but they were largely indirect and hence extremely difficult to isolate. Although personnel departments had a rough idea of their magnitude, no plant made quantitative estimates of the cost differentials by labor grade.

The trouble with the explanation that the balance between cost clean up and the required rate of return does not warrant extensive consideration of the possibilities for substitution among labor grades is that it appears to be inconsistent with the firm's interest in minimizing cost. The high rates of return firms demand are generally attributed by economic analysts either to the risks associated with innovation or to a corporate aversion to outside financing which necessitates a strict rationing of internal funds.[52] Both explanations imply that neglect of the possible savings to be gained through alternative manning arrangements is an unlooked-for side effect of an internal pricing system that has been developed for other reasons. One would expect the corporation to seek to counteract this effect. It could easily do so by insisting that the personnel department attempt more precise estimates of cost differentials and by requiring that the engineering departments take such estimates into account. These considerations suggest that the neglect of alternative manning arrangements is indicative of costs to the firm as well as to the engineer. The more plausible explanation, therefore, for the neglect of the possibilities for substitution among labor grades is the second one—that precise estimates of manning costs are too expensive and subject to too many errors to warrant the effort which they would require. This explanation was, in fact, offered by several of the persons interviewed.

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[51] All of the firms in the sample used a payout period approach to evaluate investment proposals. The required payout period varied with the nature of the project, but fell usually between 2 and 3 years, implying an annual rate of return upon invested capital of 30 to 50 percent. Because the payout period neglects returns in later years, the effective rate on some of the projects may have been considerably greater. See Joel Dean, *Capital Budgeting*, (New York: Columbia University Press, 1951) pp. 26–27. These rates are generally in line with those reported in the 1963 McGraw Hill Survey: McGraw Hill Publishing Company, *Sixteenth Annual Survey of Plans for New Plant and Equipment*, (New York: McGraw Hill, 1963) Table XII.

[52] See, for example, Dean, *op. cit.*, pp. 26–27; James S. Duesenberry, *Business Cycles and Economic Growth*, (New York: McGraw Hill, 1958), pp. 49–112; Walter W. Heller, "The Anatomy of Investment Decisions," *Harvard Business Review*, Vol. XXXIX, No. 2, March 1951, p. 101.

It is extremely difficult to define jobs on new equipment before it is actually on the plant floor. The equipment itself merely determines the set of tasks which must be performed. The jobs into which the tasks are combined will depend upon the relationship of the equipment to other tasks in the plant. It is also difficult to forecast the number of different tasks an individual operator can perform; in many cases, manning is set experimentally once the equipment is in operation. Thus even the total number of men required is often no more than a rough estimate, and any definition of specific jobs on an equipment design would lend a false precision to the calculations.

The problem of forecasting precise labor costs is further compounded by the difficulty of estimating wage rates for newly created jobs. Specific wage rates are set through elaborate job evaluation and time study procedures which involve careful observation of the job as it is performed on the plant floor, and this is not possible in the case of new equipment until it is constructed and installed. Moreover, in organized plants, rates for new jobs—and often the job design as well—are subject to union approval.[53] Rate concessions are often required to smooth the process of transition to new technology, and their character will depend on the nature of the management-employee relations prevailing at the time of introduction. Finally, it is hard to set the minimum requirements for jobs connected with new technology since, when it is first introduced, only engineers who presumably possess far more qualifications than are needed have had any experience operating and maintaining it.

It is notable, in this regard, that the one industry studied in which plants consistently costed out specific jobs on new pieces of equipment was the shoe industry. They could do so, it appeared, only because they purchased all equipment from vendors who gave them a prepurchase trial period of as much as 2 months, which the plants used to experiment with manning. One plant actually negotiated labor grades and production standards for new jobs with the union before making the decision to purchase the equipment.

The barriers to consideration of alternative manning inherent in the process of job design and job pricing are compounded by the nature of the equipment design process. The industrial engineer cannot man a piece of equipment until it is designed. Similarly, the manufacturing engineer cannot design equipment until the product design is complete. Thus, the design process follows a necessary sequence from the product engineer at the beginning to the industrial engineer at the end. This does not mean that manning considerations cannot influence the design of the product or the equipment. The industrial engineer can suggest changes in designs which will facilitate his task, and in the typical design process the design is passed back and forth among the various engineers along the sequence. Communication among the engineers is expedited when they work in teams. Eventually, however, the design must be frozen if the project is to be completed. Since the freezing begins with the product design and progresses to the equipment, it is the industrial engineer who is invariably left with the least degree of freedom.

While possibilities of substitution among various labor grades are not considered in formal costing procedures, they may influence the design indirectly. Even before they begin to cost out a project, for example, engineers may reject designs which call for types of labor that are in short supply or give rise to labor relations problems. It is extremely difficult to uncover informal influences of this kind. However, one way in which the problem can be approached is to examine the environment in which engineering decisions are made and the factors which that environment is likely to bring to the engineer's attention or remove from his purview. In large corporations this environment is carefully defined by the departmental structure. Three aspects of this structure appear to weaken the influence of the labor market: (1) the separation of operating and nonoperating divisions, (2) the gap between personnel and industrial relations departments and the engineering departments, and the low esteem in which the former are held by the latter, and (3) the division of the engineers into product engineers, manufacturing engineers, and industrial engineers.

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[53] See, for example, Pike and Fischer, Inc., *Steelworkers Handbook of Arbitration Decisions*, (Pittsburgh: United Steelworkers, 1960), pp. 63–83, 200–207.

The personnel and industrial relations departments have the most detailed knowledge about supplies of labor, both outside and inside the plant.[54] Production departments are also made aware of supply conditions to the extent that the personnel and industrial relations departments cannot fill their needs for labor. The engineers who design the equipment, however, are isolated from these other departments by the administrative structure of the corporation and, consequently, from market conditions as well.

The separation between the engineering and operating departments of the plant is not absolute: it is bridged by engineers who are on permanent operating assignments. Moreover, it is not necessarily irrational from the corporate point of view. Several managers commented that the engineering departments must be shielded so that operating problems do not interrupt the process of equipment design.

The gap between the engineering divisions and the personnel and industrial relations departments is both much wider and much less justified. This gap was painfully apparent when the personnel departments were making the arrangements for the access to engineering departments needed for this study. The personnel managers almost never seemed to be on intimate terms with any of the engineers, and in several cases did not even know the names of the heads of nonoperating engineering divisions. Moreover, the engineers appeared to hold the personnel department in very low esteem, a feeling which was reflected in that department's own highly defensive view of itself. In those few instances when personnel departments had direct contact with engineers, it was through an engineer who had been "retired" to personnel.

Within the engineering section, there is a similar hierarchy. Product engineering was the most prestigious of the three departments, and industrial engineering the least. Since the design process involves a certain amount of bargaining among the engineers, this hierarchy weakens the role of labor considerations, for these considerations enter the design process through the industrial engineer.

It is beyond the scope of the present study to explore in detail the causes for this social structure within the corporation. It seems to depend heavily on the competitive environment in which the corporation operates. In industries where the success of the corporation is highly dependent on technical characteristics of the product, the prestige of the product engineers is especially high. In such industries power is added to prestige by the fact that higher management positions are filled by product engineers. When company survival depends primarily on sales and advertising, however, sales representatives dominate the corporate hierarchy, and sales personnel have the greatest influence. In none of the plants visited was the labor market considered crucial to company survival. Indeed, in any list of factors important to the company's success, it was near the bottom. This helps to account for the position of the industrial engineering and personnel departments. A second factor is probably the lower educational attainment of industrial engineers relative to their counterparts in product manufacturing engineering and of personnel and industrial relations officers relative to engineers as a group.

In summary, the design and installation of new equipment in large corporations where the innovative process is largely internalized are responsive to the cost of labor relative to that of other factors of production, but they do not seem to respond to the relative costs of different types of labor or to other labor market indicators which should theoretically work to prevent structural bottlenecks. The various factors adduced to explain the engineers' neglect of relative labor costs are largely technical and institutional. The neglect of relative labor costs appears, then, to be built into the basic procedures for capital equipment selection. It can be argued that these procedures developed in this way largely because major structural bottlenecks have not occurred. The labor market for all of the plants in the study was relatively loose during the period in which interviews took place and had been loose, in most areas, for the preceding 7 years. During a period of tighter labor markets, when structural bottlenecks became more apparent, cost differentials among various types of labor widened, and new equipment actually stood idle for want of labor, design procedures might conceivably change. On the other hand, when the plants were visited, certain types of maintenance skills, particularly those of electronic repairmen, were in extremely short supply. Yet, although this problem was much discussed, it did not inhibit the engineers from designing and installing new equipment which required these skills.[55] Moreover, because design procedures are not set up to anticipate labor shortages and because the neglect of relative labor costs is technical and institutional rather than economic, changes in response to labor market bottlenecks are apt to take place only over a long period and after shortages have persisted for some time. The fact that the neglect of relative labor costs has been institutionalized suggests that serious bottlenecks and wide cost differentials probably have not been encountered for a very long time.

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[54] The personnel and industrial relations functions are often separated in the plant, but the two departments usually work closely together.

This inference is supported, in the main, by a similar study of technological change on the plant level conducted by Martin Segal during the Korean War, a period when labor markets were considerably tighter. Segal describes procedures for estimating labor costs on new pieces of equipment very similar to those encountered in the present study. He does report that formal cost control procedures played a greater role in the search for innovations but suggests that labor market variables only rarely influenced the selection of areas in which technological change was sought. Designing procedures appeared, if anything, less responsive to labor market influences in the earlier period than in that of the present study. In the plants Segal studied, management approved many projects without obtaining cost estimates for them.[56]

Job Design Given Capital Equipment

As was suggested earlier, the plant's products and its capital equipment determine the set of tasks which must be performed by labor. Job design is the process of combining these tasks into jobs. The primary responsibility for job design rests with the industrial engineer, but it is exercised in cooperation with the line supervisors and the personnel and industrial relations departments. In unionized plants, job design is also subject to the conditions imposed by the collective bargaining agreement.

Technically, the industrial engineer has a certain amount of latitude in that a given job can be composed of a larger or smaller number of tasks and a group of tasks may require a greater or lesser variety of skills. For example, a machine operator may be responsible for picking up his materials and delivering his outputs, or the tasks of pickup and delivery may be separate jobs performed by other workers. Similarly, the repair and maintenance of the equipment may be assigned wholly to the maintenance department, or in part to the operator. Again, the operator may set up his own machine, or there may be a separate set-up man.

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[55] Indeed, the process of costing out new equipment designs with an average wage rate will understate the labor costs when skilled labor is being used. This will lead to an overutilization of skilled labor.

[56] Martin Segal, *Some Economic Aspects of Adjustment to Technological Change*, unpublished doctoral dissertation, Harvard University, April 1953, pp. 30–91.

It is possible that the differences between the procedures reported by Segal and those found in the plants visited for the present study arise from differences in the types of management officials who were interviewed. Segal, who was more interested in the adjustment process than in design, did not interview manufacturing engineers. He reported that while higher management approved a number of projects without formal cost estimates, they did believe that estimates of the costs of alternative designs had been made by the engineers proposing the projects (p. 59).

The differences in the reported roles of formal cost systems may also arise from differences in the officials interviewed. In the plants included in the present study, many of the engineers in the operating divisions, and some of the engineers in nonoperating sections of the corporation, had formal responsibility for cost control, but most of their time was spent in activities not directly related to cost control procedures. Other officials in the corporation, however, frequently identified them by their responsibility for formal cost control and they preferred to discuss the cost control procedures in the interviews rather than to try and articulate activities to which they had given little conscious thought.

The basic skills and attributes required for production, however, cannot be changed through the process of job design since they are defined by the equipment and the product. The industrial engineer participates in the processes of equipment and product design with the primary goal of simplifying the labor tasks and minimizing the time and motion required to perform them. Once the equipment and product designs are completed, however, the industrial engineer must accept the tasks they involve and attempt to discover the optimal combination of these tasks into jobs. His only freedom is control over the arrangement of equipment on the plant floor.[57]

It was extremely difficult during the interviews to determine what actually governed the process of job design. Almost without exception, industrial engineers spoke as if it were a purely technical process that involved minimization of the number of jobs in the plant without reference to the relative costs of different types of labor or the availability of required skills. Their comments gave the impression that two engineers working independently with the same product and equipment and under the same union and management constraints would produce the same manning schedule.[58] When pressed, however, they admitted that there were exceptions. One engineer mentioned that the duties of one man in an American plant had been distributed among six men in an identical Japanese plant in order to compensate for deficiencies in skills. He was, nevertheless, very skeptical about the manning pattern in the Japanese plant and referred to it in a disparaging manner. He had not visited the plant, but refused to believe that the arrangement had worked out.

In another interview, the manager of a shoe factory admitted that under tight labor conditions he might assign pick-up and delivery tasks to separate jobs so that highly skilled machine operators who usually perform these tasks for themselves could devote their free time to production. The manager was preoccupied with this hypothetical situation throughout the interview, returning to it several times. He finally concluded that he definitely would not make the substitution.

It is possible that if they were pressed by events, these respondents would make substitutions after all. But the comments made during the interviews certainly support the conclusion that none of the varying labor market conditions the engineers interviewed had encountered had warranted adjustments through job redesign. Even though the range of conditions encompassed war periods for some engineers, and even though they were willing to admit the job changes during those periods had facilitated the use of inexperienced and poorly trained labor, the engineers were unwilling to attribute the job changes to conditions in the labor market.[59]

The weakness of labor market influences in job design, as in equipment design, was attributed partially to the minor effect that alternative manning has upon costs. As noted earlier, fixed employment costs narrow the cost differentials created by the wage structure. Moreover, the number of workers in the plant is in itself a cost factor in that, as the number of workers increases, the tasks of managing them and coordinating production become more complex. In addition, people take up space, and this was a constant preoccupation of management even in the newest plants.[60]

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[57] Nor is this an insignificant factor. It often enables the industrial engineer to vary the span of operations assigned to a given job.

[58] Cf. Louis E. Davis, Ralph R. Canter, and John Hoffman, "Current Job Design Criteria," *The Journal of Industrial Engineering*, Vol. VI, No. 2, 1955, pp. 5–8.

[59] They attributed them instead to long runs of standarized products. This effect is also noted by Melvin W. Reder in "Wage Differentials, Theory and Measurement," National Bureau of Economic Research, *Aspects of Labor Economics*, (Princeton: Princeton University Press, 1962), p. 270.

Once the tasks have been fixed by the equipment design, job evaluation systems also have the effect of narrowing the cost savings to be obtained by substitutions among labor grades. In most job evaluation plans, the rating which a job receives in a given category tends to be dominated by the highest rated task. Consider, for example, a two-part job in a shoe plant, consisting of an operating task evaluated at fifty points for skill, and a pick-up and delivery task with a twenty point skill rating. When these are combined into a single job, it receives a fifty point skill rating. If they are split into two jobs, however, the plant will be paying for fifty skill points on the first and for an additional twenty skill points on the second. This example is hypothetical. Most evaluation plans would give additional points for the second, lower rated task (although often on the basis of some other evaluation category [e.g. "range of duties"]), but jobs are seldom fully credited with the combined points of all tasks. Hence, there is an incentive to minimize the number of jobs, to the exclusion of alternative patterns of substitution.

The weak influence of the labor market may also be attributed to other technical factors which were not explicitly mentioned by the engineers but which became apparent during the interviews. Job design is constrained by a number of factors in addition to the equipment. Among these are managerial techniques, the payment system, customary law, the collective bargaining contract, safety and health standards, and plant work rules. In addition, industrial engineering is itself dominated by a set of principles. The cardinal one is that a job must be made as simple and repetitive as possible. Although these principles may have more or less objective validity, the engineers believe them to be valid.[61] In many cases, it appeared that these technical limitations completely determined job design.[62]

It was apparent during the visits to the plants that formal design is only one facet of the process of job generation when new equipment is constructed. A second facet is experimentation with job designs and manning schedules after the equipment is in operation on the plant floor. A number of examples of such "experimental" job design were observed during the visits. Indeed, the typical manning procedure for new equipment was to overman initially, and then to modify the original pattern by redistributing tasks and combining jobs. The guiding principle in this process, as in formal job design, appeared to be minimization of the *number* of workers. But availability of skills probably enters the process indirectly. In experimental job design, the manning schedule ultimately adopted will depend upon the capabilities of the workers who participate in the experiment. Jobs, in other words, are tailored to the employees initially assigned to them, and job requirements are hence adjusted automatically to their skills and other attributes. Some adjustment of this kind takes place on old jobs as well; as the operators assigned to them change in accordance with operators' capabilities. A number of adjustments of this type are examined in the next chapter.

Experimental job design is, however, a very complex process. It is to the advantage of the production worker to minimize the number of tasks assigned to a single job since this minimizes the amount of work each employee has to do and maximizes the total employment opportunities available for all workers. Thus there is a conflict between the engineers and the production worker. Initially, the engineers have the advantage in this conflict, for they designed the equipment. Once the equipment is in operation, however, the advantage begins to shift to the production worker. Through experience on the job he acquires an intimate knowledge of the equipment, develops speed in performing the work and devises shortcuts which revise the original tasks, all of which he has an incentive to hide from the engineers. In a sense, then, the experimental process of job design is a constant one, but only in the early stages is it effectively captured by the engineer's formal manning specifications. Older equipment in the plant is probably overmanned, both in terms of absolute numbers of workers and in terms of formal skill requirements.

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[60] The "nightmare" of operating his plant with a large labor force was one of the factors upsetting the shoe plant manager.

[61] A much wider disagreement is present in the scholarly literature about the optimal job design than was evident in the comments of industrial engineers in the visited plants. See, for example, Eaton H. Conant and Maurice D. Kilbridge, "An Interdisciplinary Analysis of Job Enlargement: Technology, Costs and Behavioral Implications," *Industrial and Labor Relations Review*, Vol. XVIII, No. 3,1965 pp. 377–395.

[62] See, for example, William Grant Ireson and Eugene L. Grant (eds.), *Handbook of Indstrial Engineering*, (Englewood Cliffs, N.J: Prentice-Hall, Inc., 1955), particularly the articles by Dale Yoder (pp. 173–282), Marvin E. Mundel (pp. 283–392), and William Gomberg (pp. 1121–1184) for the constraints imposed by managerial techniques, engineering principles, and trade unions, respectively.

Experimental job design is only possible, however, when management is free to change the manning pattern after the equipment is on the floor. Management retained this freedom in all of the plants observed, but in some industries union rules severely restricted it. In the basic steel industry, for example, the collective bargaining agreement sets very stringent limitations upon job changes,[63] and much greater emphasis seems to be placed on "theoretical" job design before the equipment is on the floor. The engineers apparently try to err in the direction of undermanning.[64]

In conclusion, study of job design in the plants visited suggested that once capital equipment is installed, jobs are adjusted to the characteristics of the available labor force. Although the engineers claimed that labor market variables did not influence formal job design, many job designs were developed experimentally, and when this is the case, jobs are automatically adjusted to the characteristics of their incumbents. Moreover, since operators are able to hide actual manning requirements from the engineer and since equipment consequently is overmanned, there is slack for adjustment to a tightening labor market.

The Role of Outside Institutions

The process of innovation described in the preceding sections prevails only where innovation is completely internalized. Complete internalization is characteristic only of plants which are attached to large, multiplant corporations or which produce highly specialized products and even these plants frequently call upon outside sources for a large number of innovations. On another level, however, the completely internalized process can serve as a basic model or ideal type of the innovative process generally. At this level the participation of external institutions can be viewed as a substitution for all or part of the internal process.

In practice, the combinations of external and internal participation are infinite. The plant may hire engineering consulting firms to conduct the search for innovations. Manufacturers of specialized equipment may be used to design and construct the innovation once the area to which it applies has been selected. These manufacturers may also construct projects which were designed internally, or design projects for internal construction. Outsiders can work either in cooperation with the firm's own engineering staff or independently of them.[65]

So long as the firm's own engineering staff maintains some control over the process, the points at which the influence of the labor market is felt are very much the same as when the innovative process is completely internalized. The influence of the labor market may be weaker, however, for there is a greater separation between the innovator and the personnel, industrial relations, and operating units. In one situation—when a firm purchases standard equipment from vendors of mass-produced equipment models—innovation achieved through the participation of outside sources does appear to differ substantially from the wholly internalized innovation process. This pattern of innovation is therefore examined separately. Although the process which will be described here is approximated in practice, it is, in a sense, another ideal type. Almost every firm makes at least minor alterations in the standard equipment models it purchases. Firms with specialized needs are frequently able to persuade the vendor to make alterations for them and even to design these alterations.

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[63] See Pike and Fisher, op. cit., pp. 26–105, 191–194, 207–212 223–224.

[64] This point was made in conversation with an executive of a major steel company which was not included among the firms visited for this study.

[65] See Bright, op. cit. pp. 107–122. Also, Paul W. Cherington, Merton Peck, and Frederic M. Scherer, "Organization and Research and Development Decision Making Within a Government Department," and Robert S. Merrill, "Some Society-Wide Research and Development Institutions," in National Bureau of Economic Research, *The Rate and Direction of Inventive Activity*, (Princeton: Princeton University Press, 1962), pp. 395–408 and pp. 409–434 respectively.

When the firm introducing the innovation into the manufacturing process purchases it ready-made from a vendor, the three stages of the innovative process—search, design of equipment and job design—are actually repeated twice, first within the firm of the vendor and then within the plant of the customer. It is convenient to discuss the process within the customer's plant first.

The customer's search consisted primarily of a review of standard equipment models already designed and constructed by the vendor. Although the search was often sparked by specific problems encountered in production, more frequently the customer first learned about the new equipment and then investigated his own process to determine whether there were areas in which it might prove useful. The customer's search, then, depended largely on the periodic visits of salesmen, and upon exhibitions, magazines, and other literature in which new equipment is advertised.

In large plants, the search continued to be conducted by the operating personnel. The standard vendor models were treated as competitive with internal designs, and the end product of the search was typically a list of standardized models and internally designed alternatives to them.

In smaller plants and in plants belonging to relatively small corporations, the plant manager played the major role in the search. Lower level managerial personnel, who were closer to the operating situations, generally had a weak technical background and could not evaluate the literature and other channels of information. They could not, moreover, be as easily spared from other duties to talk with salesmen, nor could the company afford to send them to trade fairs.[66] In the small plants and corporations, as in larger ones, the end product of the search was a list of various models, often produced by several vendors, of a standard type of equipment, but these lists did not contain internally designed alternatives.

When the plant manager rather than line management conducts the search, the labor market probably has a smaller influence because the level at which the decision is made is not the operating level at which the impact of changing market conditions is felt more keenly. The significance of this should not be exaggerated, however. Several of the plants in which the manager conducted the search were smaller than the unit supervised by a departmental foreman in the largest plant in the sample.

The sample did not include any very small concerns, but other studies of investment decisions in these enterprises indicate that the search is very limited, the firm often evaluating only one model and accepting or rejecting the innovation on that basis. The model is often suggested by a salesman, who in this case plays a role equivalent to that of the plant manager or the operating personnel in the search of larger firms. The manager (who is often the owner as well) does not have time to tap other channels of information and frequently lacks the technical competence to do so.[67]

The customer's search is followed by an analysis of the relative costs of different models, which is the equivalent of the design stage in the internal innovation process. Although the costing process was far from uniform, the labor market appeared to have more influence than it had in the internal design process. In shoe plants—the only plants in the study that were almost wholly dependent upon standardized equipment—alternative models were actually tested on the plant floor before they were purchased. The plant could therefore base its decision upon exact information about the manning requirements of the equipment. This procedure may be peculiar to the shoe industry and is possibly an outgrowth of the earlier practice of renting capital equipment from the United Shoe Machinery Corporation. Such detailed experimentation and costing was not observed in other plants purchasing standard equipment from vendors, but more attention did seem to be given to labor requirements, if only because these were more readily defined in relation to standardized equipment. The kind of experimentation with equipment and manning patterns noted in the shoe industry, however, is not possible in very small job shops where there is only one unit of the equipment on the floor. Nor can it occur in integrated assembly-line production, where every operation on the line must be synchronized with the operations which precede and follow it.

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[66] The difference between the technical background and the responsibilities of line management in the small and large plants is curious. One explanation for this difference is that the large plants simply have more "fat" in the budget and can therefore afford to have a better educated and more relaxed supervisory force. But another explanation is that larger plants and corporations hire college graduates for lower level managerial positions because the extensive managerial structure offers promotion opportunities not available in small firms. Promotion opportunities provide an incentive for college graduates to accept lower level jobs, and these lower level jobs provide a kind of on-the-job training, which is useful and possibly even critical in higher positions. Once lower level management is filled with college graduates, it may then be more profitable to reduce their supervisory functions and encourage them to engage in innovative activity.

[67] Martin B. Solomon, Jr., *Investment Decisions in Small Business*, (Lexington: University of Kentucky Press, 1963), pp. 95–101. See also George Terborgh, *Investment Policy—A Challenge to American Management*, (Washington: Machinery and Allied Products Institute and Council for Technological Advance, 1964), pp. 12–14.

Once the standard models had been purchased, the procedures used in the design of jobs did not differ greatly from those followed in the internal innovation process. Standard models were almost always accompanied by manning recommendations, but customers generally experimented with alternative manning arrangements, using the vendors' recommendations as little more than a standard of comparison. Several respondents maintained that labor requirements were invariably underestimated in the vendor's recommendations. One vendor admitted that this was probably the case, explaining that the manning schedules were based on ideal engineering standards.

The fact that the customer is not bound by the vendor's recommendations would appear to permit conditions in the customer's labor market to influence job design. However, as was the case when plants built their own equipment, labor market variables were not of immediate concern.

An innovative process also takes place in the vendor firm which is complementary to the customer's innovative process. From the viewpoint of society it is here that the innovation actually originates, and the three stages—search, equipment design and construction, and job design—follow in sequence, just as they do when innovation is internalized. In the internalized process, the search was seen to be a joint product of production, dependent upon the intimate knowledge of equipment acquired through operating experience and upon the stimulus provided by an operating environment. Although this alliance between production and innovation appears to be impossible when the vendor originates innovations, in practice the relationship between the vendor and the customer is far more complex than the terminology suggests. The vendor usually installs new equipment on the customer's premises and frequently trains the customer's personnel to operate it. Many vendors also offer a variety of specialized services on a permanent basis. The United Shoe Machinery Corporation, for example, sells not only equipment but also engineering consulting services, repair and maintenance service, and operator and craft training. Vendors of machine tools and business machines supply a similar range of services. In addition, the relationship between the vendor and his customers is extended on an informal basis. The salesman often assumes the role of engineering consulant, discussing operating problems with the plant departmental manager during his visits and often spending time on the plant floor viewing the problems directly and talking with foremen and production and maintenance workers. Such visits can last as long as a day or two.

This extended contact with the customer's production problems enables the vendor to utilize the customer's operating experience in the search. Vendor salesmen and customer services departments, through which the contacts take place, then play the role of line management in the search stage of internally originated innovations.

In the design and construction of vendor-originated innovations, the product engineers play a role analogous to that of the manufacturing engineers in the internal innovations process. The product engineering department also develops manning recommendations.

The labor market seemed to exert a weaker influence upon vendor innovations than upon internal innovations. As noted earlier, the product engineering departments in the sample appeared to be generally less inhibited by economic constraints than were other engineering departments and freer to concentrate on technical perfection. The physical separation between the customer and the vendor insulates the product engineer from knowledge of labor market conditions more completely than do the administrative divisions within a single plant or corporation. Moreover, because the vendor is developing a standardized product to be sold to a number of different plants, frequently in a variety of industries, and invariably in different geographical labor markets, the problem of selecting a meaningful cost of labor figure is more difficult. Even when assessing overall labor requirements, the product engineers were more concerned with numbers of people than with labor costs and seldom broke down requirements into types of labor.

Looking at this process of innovation as a whole, the labor market appears to have more influence on customer decisions and less on vendor decisions than it has when the innovation process is completely internalized. However, the fact that vendors are relatively unconcerned about labor market factors suggests that the labor market must play a minimal role even in customer decisions. If this were not the case one would expect competitive pressures to force the vendor to give them greater weight.

That the labor market plays a minimal role in the customer-vendor innovative process is suggested by another consideration. Given geographic and industrial differences in labor market conditions and wage structures, one would expect vendors to specialize in slightly different products adapted to one labor market or another, and customers to rely primarily on one or a few vendors. The number of vendors studied which produce similar equipment was too small to permit investigation of the vendor's side of this question. It was possible to examine customer behavior in this regard. None of the plants in the sample, all of which were customers for some types of standard equipment, exhibited a tendency to rely exclusively or even primarily on one vendor rather than another. Indeed, any such tendency was denied in the interviews, and the denials were confirmed by the variety of brands found on the plant floor. Variety prevailed despite the fact that use of one or a very few brands simplifies maintenance problems and facilitates transfers of workers within the plant.

Another piece of evidence which supports the conclusion that labor market considerations play a minimal role in equipment design was provided by the experience of one shoe corporation which has plants throughout the country and which made more careful and elaborate estimates of labor requirements before new equipment was introduced than any other plant studied. Mechanization of this corporation's operations had proceeded more rapidly in southern plants where labor costs were lowest and the specialized skills required by the new technology in shortest supply.

6. LABOR FORCE ADJUSTMENT THROUGH TRAINING

In the preceding chapter it was shown that the process of technological innovation and job design, one of the equilibrating mechanisms assumed in neoclassical economic theory, is relatively insensitive to labor market conditions. The weakness of this mechanism implies that technological change is as likely to create structural bottlenecks in the labor market as not, and that any compatability between the job structure and the structure of the labor force is purely fortuitous.

The historical record on this point is a matter of some controversy. In periods of high unemployment and rapid technological change, at least as the matter is measured by the rate of increase in productivity, theories of structural unemployment have achieved a certain currency.[68] But the difficulties of separating the structural component of unemployment from the inadequacy of aggregate demand have made it impossible to substantiate such theories empirically.[69] Nonetheless, the recent reductions in unemployment under the impact of strong govermental stimulus to demand, although far from conclusive in this respect, seem to undermine the explanation of the unemployment rates of the late 1950's and early 1960's based on structural theories. Moreover, at the time the interviews for the study were conducted, this procedure did not show a tendency toward increasing labor market orientation that one would have expected had the market been experiencing serious structural imbalances and the plants been unable to obtain the labor force they required. And, historically, the labor market has remained far closer to equilibrium than one would expect if no coordinating mechanism were operative. This suggests that there may be other mechanisms, not incorporated in neoclassical theory, operating to reconcile the structure of the labor force with the structure of jobs.

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[68] The recent literature is reviewed in Barbara R. Bergmann and David E. Kaun, "Structural Unemployment in the United States," (Washington: Brookings Institution, 1965), chap. II. Unpublished manuscript.

The literature of the Industrial Revolution and of the 1920's and 1930's is reviewed in detail in Lewis L. Lorwin and John M. Blair, *Technology in Our Economy*, Washington(Temporary National Economic Committee, 1949), Monograph 22, pp. 3–83. This volume is also illustrative of the concerns of the 1930's as are the other monographs in this series and the studies of the Works Progress Administration, National Research Project.

The major product of the concern in the 1920's is: Committee on Recent Economic Changes of the President's Conference on Unemployment (the Hoover Committee), *Recent Economic Changes in the United States*, 2 vol.. (New York: McGraw-Hill, 1929). In this period see also Harry Jerome, *Mechanization of Industry*. (New York: National Bureau of Economic Research, 1934).

The TNEC and the Hoover Committee reports are earlier analogues of *Technology and the American Economy*, (Washington: National Commission on Technology, Automation, and Economic Progress [The Automation Commission] 1966), Vol. 1.

[69] See Richard G. Lipsey, "Structural and Deficient-Demand Unemployment Reconsidered," in Ross (ed.), *Employment Policy and the Labor Market*, (Berkeley and Los Angeles: University of California Press, 1965), pp. 210–255. See also Bergmann and Kaun, op. cit., chap. 2.

Training

Training in the Plant on the Job

In the plants included in the study, much of the adjustment in jobs and worker characteristics required by changes in technology appeared to take place through in-plant training. Because of their importance in the adjustment process, in-plant training procedures are explored in some detail.[70]

Although surprisingly little is known about the processes by which job skills are acquired in the American economy, it is apparent from the data that are available that in-plant training plays a predominant role, particularly for blue-collar production and maintenance crafts in manufacturing. (See table 2.)[71]

In itself this may only indicate that the locus of training has shifted. Neoclassical theory tends to view the educational system as a separate industry and the removal of training to the plant as a form of vertical integration. The integration may affect the distribution of training costs between the employer and the employees, but need not change the essence of the training process.[72] Judging from the plants included in this study, however, the internalization of training changes the training technique as well. In-plant training in these plants took a variety of forms, and any single job was taught differently at different times in the same plant. But the predominant pattern—and the one which appears to be most critical in adjustment to changing technology—was a process of informal training on the job in the process of production. The typical worker in the manufacturing sector just "picks up" his skills by what one observer has termed a process of "osmosis."[73]

For relatively simple operating jobs new workers receive a brief job demonstration and are then placed directly on the machine. As they begin to produce on their own, they are corrected by the foreman or by neighboring operators and, in this way, acquire speed and accuracy. On complex jobs, particularly in maintenance and repair, the novice may serve as an assistant to an experienced employee whom he eventually replaces. Sometimes the position of assistant is a regular job, part of the normal staffing pattern. In other cases, it is a trainee position, not otherwise filled. In still other cases, training takes place along a promotion ladder: work on lower level jobs on this ladder develops skills which are a prequisite for learning the more complex skills required on the jobs higher up the ladder. Alternatively, workers in a department frequently learn other jobs by observing their neighbors and by practicing on, or "playing around with" the equipment during their lunch hour[74] so that, although the jobs within the department are not skill related, the ability to perform a given job is related to the length of time the worker remains in the department. Job skills are also acquired during temporary work assignments: an inexperienced

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[70] Some of the material in this section was presented in abbreviated form in Peter B. Doeringer and Michael J. Piore, "Labor Market Adjustment and Internal Training," Industrial Relations Research Association, *Proceedings of the Eighteenth Annual Winter Meeting*, (Madison, Wisconsin: 1965).

[71] More detailed data are available in the monograph from which this table is derived: U.S. Department of Labor, *Formal Occupational Training of Adult Workers*, (Manpower/Automation Research Monograph No. 2, December 1964), Table 11, p. 43–45. Similar results are reported in a more intensive Canadian study of manufacturing craftsmen, in which the training of native craftsmen is compared to that of European immigrants in the same trades. Formal training was considerably more important for the Europeans. Department of Labour, Canada, *Acquisition of Skills*, Research Program on the Training of Skilled Manpower, Report No. 4 (Ottawa: Queen's Printer and Controller of Stationery, 1960). The training of construction craftsmen is often equally informal; see George Strauss, "Apprentice: An Evaluation of the Need," in Ross, op cit., pp. 299–332. See also National Manpower Council, op. cit., pp. 208–233.

[72] See Gary Becker, op. cit., pp. 7–37.

[73] Melvin W. Reder, "Wage Differentials: Theory and Measurement" in National Bureau of Economic Research, *Aspects of Labor Economics*, (Princeton: Princeton University Press, 1962), p. 271.

[74] This type of training is also common in some construction crafts. For example, Garth L. Mangum, *The Operating Engineers*. (Cambridge: Harvard University Press, 1964), p. 276.

TABLE 2. REPORTS BY WORKERS ON LEARNING OF CURRENT (OR LAST) JOB SELECTED MANUFACTURING JOBS

[Persons 22 to 64 years old in civilian labor force who completed less than three years of college. Percent distribution]

Current or last job	Ways in Which Job Was Learned[1]					Most Helpful Way Job Was Learned						
	Formal[2]	On the job[3]	Casual[4]	No training needed	Not available	Formal	On the job	Company training	Worked way up by promotion	Casual	No training needed	Not available
Technicians, electrical and electronic, and other engineering and physical sciences	54.2	83.5	30.2	4.7	--------	19.8	34.4	6.1	5.2	6.1	4.7	23.6
Other technicians (nec)[5]	54.4	73.5	23.5	2.2	--------	28.7	36.8	5.9	1.5	8.0	2.2	16.9
Foremen, manufacturing	32.6	85.9	33.8	--------	1.3	9.2	25.6	5.3	23.4	14.4	--------	22.1
Machinists	56.1	70.9	36.6	--------	.5	31.4	28.8	4.7	2.6	10.9	--------	21.6
Mechanics and repairmen	43.4	60.0	52.4	2.5	.5	15.3	25.4	5.6	2.1	30.3	2.5	18.9
Toolmakers, and die makers and setters	64.6	55.2	32.6	4.4	--------	41.4	17.1	2.8	4.4	13.8	4.4	16.0
All other craftsmen and kindred workers	34.2	69.7	41.3	1.4	1.4	12.7	35.7	3.3	6.6	21.7	1.4	18.7
Assemblers	11.9	81.2	28.4	6.9	.3	3.2	63.9	3.8	.5	14.9	6.9	6.7
Checkers, examiners, and inspectors, manufacturing	15.8	85.8	32.1	4.5	.9	8.1	55.3	5.7	2.6	9.1	4.5	14.7
Filers, grinders, and polishers, metal	13.3	66.1	39.4	7.9	--------	3.0	49.1	1.8	1.8	26.7	7.9	9.7
Packers and wrappers	4.8	60.2	41.6	13.6	1.1	.5	41.6	2.0	1.1	25.6	13.6	16.3
Sewers and stitchers, manufacturing	12.4	60.2	40.3	3.2	1.5	6.4	47.3	5.3	.7	30.8	3.2	6.3
Welders and plane cutters	41.3	62.4	34.9	4.2	--------	18.7	30.7	7.7	2.1	22.3	4.2	14.3
Other operatives	17.6	71.4	36.6	5.1	1.9	6.8	43.6	6.0	4.0	20.0	5.1	14.4
Manufacturing operatives and kindred workers (nec)	10.8	73.8	34.5	6.4	.9	3.4	54.2	2.8	2.9	20.1	6.4	10.3
Laborers (nec), manufacturing	5.1	47.3	44.6	18.4	3.1	1.9	32.1	1.1	2.2	31.1	18.4	13.1

[1] Because workers learned jobs in more than one way, the sum may exceed 100.0 percent.

[2] Includes schools, apprenticeship, and armed forces.

[3] Includes on–the–job, company training, worked way up by promotion.

[4] Includes "relative or friend," "just picked it up," and "others."

[5] Not elsewhere classified.

Source: U.S. Department of Labor, *Formal Occupational Training of Adult Workers*, Manpower/Automation Research Monograph No. 2, December 1964, Table 11, p. 43–45.

man may, for example, stand in for the regular incumbent when the latter is temporarily forced to leave his station, and for more extended periods, when the incumbent is late, sick or on vacation.

Despite such diversity, all of these training patterns have three common features which make it useful to analyze them as a group: 1) the training takes place on the job; 2) it occurs in the process of production; and 3) it is highly informal. The informality of the training procedures in the plants visited was particularly striking. Job skills were communicated orally and through demonstration, and were learned by practice and repetition. The larger plants in the sample had written job descriptions, but these were designed for use in wage administration and in recruitment and screening. They were seldom, if ever, referred to in the actual training. And even in wage administration and hiring they appeared to serve only as guideposts. During the interviews managers continually paused to reinterpret them, adding phrases, interpolating words, and so on. An uninitiated worker, reading the description without ever having seen the job performed, would find little to help him actually do the job.

Instruction manuals were also conspicuously absent. In those plants where they existed, they were used as maintenance guides, apparently designed for those already familiar with similar pieces of equipment and the specialized vocabulary associated with them.

In short, the jobs exist only as work performed on the plant floor; continuity of job activity, from one generation of employees to another, is achieved through a process of direct transmission, orally and by example, from the incumbent to his successor. Thus the incumbent serves as teacher and his eventual replacement as student.[75]

However, the concept of a teacher-student relationship must not be understood too literally. The analogy can be misleading in several respects. First, many facets of manufacturing jobs are self-taught. This is particularly true for relatively simple operating jobs on an assembly line, where the critical "skills" are speed and accuracy. These jobs call for certain habitual manual movements, learned by rote through continual practice and repetition. Indeed, plants generally define training for these jobs in terms of a learning curve showing the rise in the worker's productivity over time: the "trained" worker is one whose learning curve has levelled off; outside of this learning curve, "training" and "skills" have little meaning.

The learning curve also characterizes "skill" components of a number of jobs to which it is not generally applied. Even for maintenance crafts, which require considerable ingenuity and improvisation, the speed with which difficulties can be diagnosed and repaired is critical, and this speed is frequently dependent upon the number of situations the craftsman has memorized. A partially trained craftsman is familiar enough with the equipment so that the mental process and experimentation he goes through to diagnose trouble and correct it are relatively brief. The fully trained craftsman knows immediately how to proceed. Here, as for simple assembly jobs, a good part of the learning process consists of practice and repetition.

A second characteristic of the teaching function in on-the-job training is that many job skills which *need* not be self taught can be. A novice can learn to do a job by trial and error, but a "teacher" can shortcut this process by timely advice and assistance. His presence not only saves the labor and machine time involved in learning by trial and error, but also helps to avoid the machine damage and material wastage which such trial and error learning frequently entails. One type of work in which trial and error learning is possible but expensive is machine repair: here an inexperienced man may eventually be able to repair a machine simply with the aid of an instruction manual, but he can do so more efficiently under the supervision of a craftsman already familiar with the equipment. Similarly, on almost any production job, unusual emergencies can arise and one of the important "skills" of the experienced operator is to know what to do, even if this knowledge involves nothing more than the ability to call for help in a way which obtains it quickly. The novice will learn how to do this after one or two emergencies, but the emergencies will be less catastrophic if either a supervisor or an experienced operator is nearby to direct him.

This leads to the third characteristic of teaching on the job. Very frequently, training is merely a matter of demonstration. The student absorbs the job skills by watching the experienced operator perform, and little or no instruction in the conventional sense is required.

Together, these aspects of the teaching function in on-the-job training imply that there is considerable elasticity in the amount of teaching time and the intensity of teaching effort which need to be devoted to individual students. If a firm is forced to do a lot of training by unusually high rates of attrition, an expansion in productive capacity, or a change in technology, the amount of individual attention can be reduced. A variety of adjustments of this kind was encountered in this study. For example, the number of assistants working under a given maintenance craftsman frequently varied with the plant's training requirements. A supervisor who normally would have one or two trainees in his department might find himself with a large group of inexperienced hands. An operator who usually trained a single replacement might be assigned to supervise and train several new employees at once. Similar examples can be given for every type of on-the-job training situation.

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[75] The necessity of having the incumbent train his replacement can present major industrial relations problems if the incumbent desires to retain the job and refuses to provide the training. See, for example, John T. Dunlop and James S. Healy, *Collective Bargaining: Principles and Cases*, (Homewood, Ill.: Richard D. Irwin, Inc., 1953), p. 281.

Because training takes place in the process of production, both the "student" and the "teacher" perform roles in the manufacture of the product coincident with (and, in fact, as part of) their roles in the training process. Adjustments in the student-teacher relationship therefore involve a substitution of low-skilled for high-skilled labor in the process of production. The teacher's role is generally to demonstrate tasks that the trainee cannot do himself and to overcome difficulties that the trainee works himself into. In effect, this means that the trainee is assigned the lesser skilled elements of the job while the teacher confines his duties to the more complex tasks and to emergencies. This is especially apparent when a journeyman craftsman is assigned an assistant, for in this case it is easily possible to differentiate high- from low-skilled tasks. The same situation occurs, however, on simpler production jobs when the supervisor or a neighboring operator absorbs duties normally attached to the job which the trainee is learning.

A second effect that occasionally occurs in production as adjustments are made in the number of students assigned a given teacher is the temporary curtailment of certain highly skilled tasks that the "teacher" normally performs. For example, one of the tasks of the supervisor on an assembly line is to expedite production. He does this in a variety of ways, ranging from developing minor innovations in the productive process to investigating delays in other departments whose inputs are critical to his own. When the number of inexperienced workers in his department increases, he is forced to devote more time to supervising their work. His expediting activities are inevitably curtailed.[76] It is to be noted in this particular case that the tasks curtailed are essentially "hidden" aspects of the productive process. Technically, production is not supposed to require expedition, and the tasks of expedition are seldom explicitly defined or even clearly understood. In fact, management may not be aware that they have been curtailed. They do affect plant productivity, however, and when they are curtailed, productivity declines. Thus, in addition to the reduction in productivity represented by the learning curve of the operator-trainee, the training process will involve other reductions in productivity resulting from the diversion of experienced personnel to training.

Thus training adjustments may be viewed either as an adjustment in the teacher-student ratio or as an adjustment in the process of production through job modification. This dual view is of more than semantic interest. It means, among other things, that while adjustment to a shortage of experienced labor appears, at first, to be accomplished through a reduction in demand, this is only the transitory effect of an adjustment process that in the long-run relieves the shortage through an increase in the supply. This has important implications for assessment of the impact of technological change and the process of adjustment to it.

It is easier to characterize on-the-job training than to explain its predominance in the development of production and maintenance skills. It appears to be essential to the learning process for some "skills." The ability to anticipate and diagnose trouble on a piece of operating equipment, for example, requires close association with that particular equipment over a prolonged period of time. It cannot be acquired in a formal classroom or in an environment that attempts to simulate the production process with analogous equipment off the plant floor. Similarly, the muscular coordination involved in rapid, efficient assembly requires practice on the equipment itself. It might be possible to teach certain muscular movements off the plant floor, but to do so it would probably be necessary to simulate the operating situation so closely that the trainee might as well be producing the product at the same time. Under these circumstances, in other words, the finished product may be viewed as a free byproduct of training captured by conducting the training on the job. Another free byproduct is the scraps of teacher and student time not devoted to the educational process.

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[76] See, for example, Charles R. Walker, Robert H. Guest, and Arthur H. Turner, *The Foreman on the Assembly Line*, (Cambridge: Harvard University Press, 1956), passim.

In other situations, training appears to be a free byproduct of production. This is the case, for example, when inexperienced operators learn jobs in the department by "playing around" with idle machines during their lunch hour and other production breaks: here, the machine time, the student's time and the time of the experienced operator who stays around to show the novice how the equipment works, carry no cost to the plant. Similarly, the automatic learning that occurs along ladders of promotion, or when an operator learns his neighbor's job by watching him perform it, are largely free.

Even when it is not essential and not free, on-the-job training may nonetheless be more economical than alternative types of training. It has certain technical characteristics that are difficult and expensive to reproduce outside the plant. First, instruction on the job is individual, tailored automatically to the learning capabilities and peculiarities of the trainee. Second, the relevance of the instruction to the job is immediately apparent. This tends to make the trainee a more attentive student and add weight and interest to what he is learning so that it is less easily forgotten. Third, the informality of the teaching process, its highly personal character, and the fact that much of the teaching takes place through demonstration rather than verbal communication allow persons incapable of teaching in a classroom to serve as instructors.

Additional economies may accrue from the fact that the on-the-job training program is derived from the job itself; it is confined to the specific set of skills required for the job and therefore involves no excess training. On the other hand, the narrowness of the training may in the long run prove to be a drawback in adapting the labor force to the changing job requirements of a dynamic economy. The skills it excludes may be more difficult to teach at some later date, either because the employees who must learn them are older, or because the learning environment in which they are most readily absorbed cannot be readily reconstructed, or because it may be difficult to teach a new way of performing an operation to workers used to another way.

Finally, on-the-job training may be more economical than formal classroom teaching because of the small number of trainees required at any given time and the short training periods needed for many jobs. If the first were a major factor in explaining training on the job, however, one would expect to find a shift toward formal classroom training as the number of trainees increased. Such shifts were indeed encountered in several of the plants when sharp increases in the number of new employees occurred. In these cases, however, the managements explained that there simply had not been enough experienced employees to communicate the desired information in any other way, and the plants invariably resorted to more informal teaching techniques even before the number of trainees fell to the level at which on-the-job training was usually conducted.

While all of these factors appear to play a role in explaining the predominance of on-the-job training, that phenomenon can be overrationalized. The dual view of the training process as one of substitution in production is germane here. In a number of situations, training was clearly an incidental byproduct of what were essentially substitution patterns introduced ad hoc in an attempt to meet immediate production targets. In theory, variations in product prices should eliminate bottlenecks in supply, and the plant should never find itself unable to meet demand. In fact, however, product prices are sufficiently inflexible, even in an upward direction, that the plant occasionally finds demand pressing against the technical limits of productive capacity. Management is nonetheless reluctant to turn away customers for fear of losing their demand in some future slack period. Some of this unusually large demand is, therefore, reflected in raised production targets for various plant departments which are expected to attempt to meet them by any feasible means. The attempt typically involves a series of ad hoc changes in staffing patterns and substitutions of inexperienced for experienced labor. A number of unplanned learning situations are created in this way.

To a certain extent, on-the-job training itself reinforces this pattern. Its informality obscures the adjustments in labor utilization which take place as supplies of trained labor vary relative to plant demand; thus it becomes difficult to plan tight production schedules in advance. Higher management, knowing that adjustments can be made but unable to predict in advance what these adjustments are or how far they can go toward overcoming constraints that appear to limit production, deliberately builds pressures into its production targets. It simply hopes that the pressures will be sufficient to bring forth the needed adjustments but not so great as to be unmanageable. The difficulties of foreseeing what adjustments are needed are very similar to those of attempting to predict the manning requirements of new equipment. Indeed, production pressures produced ad hoc training adjustments occasionally derived from this latter source as well.

In fact, on-the-job training is related not only to the process of design of new equipment, but also to a number of other features of the manufacturing plant discussed in previous chapters: The strength of the internal labor market; the practice of promotion from within, along defined ladders of promotion; customary law; and the empirical base of technology. To the extent, for example, that the supply of labor for most jobs is confined to labor already within the plant, the number of students for any given job is small and formal classroom training is discouraged. Similarly, if the firm is forced by institutional pressures to define and adhere to seniority districts, it has an incentive to attempt to construct these districts so that the training needed to facilitate movement within them is as inexpensive as possible. On the other hand, on-the-job training, to the extent that it is necessary and economical, reinforces the internal labor market and the practice of promotion along defined ladders. In other words, on-the-job training appears to interact with procedures of internal promotion; it operates to strengthen these procedures and is, in turn, reinforced by them. An analogous interaction occurs between on-the-job training and the empirical base of technology. To the extent that the techniques are unwritten and exist only in operation on the plant floor, the institution of training programs off the job will involve special efforts to study the job and abstract the technique, and therefore will be discouraged. On the other hand, so long as training takes place on-the-job through the direct transmission of technique from the incumbent to his replacement, the incentive to record changes in techniques as they take place is reduced and the empirical evolution of technology is encouraged. These examples of interaction between on-the-job training and other features of the plant's operation suggest that the whole complex of features characterizing the manuacturing plant can best be understood together, a point which will be explored further in the next section, in an evaluation of the process of adjustment to technological change.

Adjustment to Technological Change[77]

The plant labor force adapts to minor innovations in much the same way that new workers adapt to the technology prevailing when they enter the plant. The engineer or supervisor who develops an innovation demonstrates the new techniques to the incumbent operator who then perfects the skills required while performing the job. As noted earlier, many of the minor innovations are made by the operator himself. When this occurs, the process of developing the innovation and of perfecting the new skills are virtually synonymous. The fact that jobs are learned by rote and performed without reference to written job descriptions facilitates such minor changes, and gives to both the job and the training program much of the flexibility of customary law. The worker, in adopting an innovation, forgets the old way of doing the job. When he or his supervisor subsequently begins to train his replacement, the training program is automatically adjusted to any changes which have occurred since the last time the job was taught, because it is based directly on how the job is currently done.

Major innovations in technology cannot be accommodated in this way. It is the essence of major innovations that they create discontinuities in the transfer of job skills which can be overcome only through a revision of normal training patterns. Two types of innovations can be distinguished: 1) Those which redistribute employment opportunities among existing jobs, and 2) those which create new types of jobs. In the former case, there are at least some employees who are experienced in the expanding job categories and who can serve as "teachers." In the latter case, no "teachers" are available.

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[77] See supra, chap. 3, pp. 34–76.

This distinction is admittedly somewhat artificial. Technological innovation will always create some changes in existing jobs.[78] On the other hand, changes in technology seldom create jobs which do not require any of the skills needed for the jobs predating the change. While the distinction between the two types of change is difficult to apply in practice, therefore, it is nonetheless useful for analysis of the training adjustments which take place within the plant.

Adjustments to change in the distribution of employment. Where the effect of the change in technology is primarily a change in the distribution of employment among existing jobs, the basic adjustment patterns are essentially the same as those which occur whenever demand for a given type of labor increases relative to the normal source of supply. They thus resemble patterns of adjustment to a plant expansion, an unusual increase in labor turnover, or a tightening of the external labor market. They rely heavily upon the elasticity of the on-the-job training procedures discussed in the previous section. Two forms of adjustment appear to predominate: changes in the teaching and learning patterns and changes in promotion patterns.

Little needs to be added to the preceding description of changes in teaching and learning patterns. The amount of assistance received by an individual worker in the expanding job category decreases, but since the number of inexperienced workers has increased, the supervisors and experienced workers who provide this assistance are increasingly diverted from their normal tasks. These adjustments reduce the efficiency of the plant's operation and are reflected in almost every component of cost (labor productivity, material wastage, machine downtime, and so on).

The changes in promotion patterns involve increases in the rate of promotion along ladders that have traditionally led to the expanding job categories and rearrangement of promotion lines to draw upon supplies of skills which are useful on the expanding jobs but which have not previously been tapped.[79] The effect of these adjustments depends very much on the structure of the preexisting promotion ladders.

Because workers often pick up automatically the skills required on higher level jobs that are technically or geographically related to their own, they may become ready for promotion before the opportunity for it materializes. When this is the case, there is an excess supply of skilled labor along promotion ladders, and the plant may be able to fill the jobs created by the change in technology at no cost. The likelihood of this happening depends not only on how automatically training takes place along the promotion ladder, but also upon its shape. In general, the more "pyramidal" the structure of employment, the larger will be the supply of workers on the promotion ladder.

When no excess supply of workers exists, the rate of promotion along existing job ladders may still increase. Even though they are not fully trained, workers along these ladders often constitute the most qualified supply of labor. Under such circumstances, however, the employees on the jobs created by technological change will be less efficient than employees in that job category before the change occurred. Moreover, there may be a decrease in efficiency in the lower jobs on the promotion ladder, for these also may have to draw upon less than fully trained labor to replace the workers promoted to the newly created jobs.

When traditional promotion ladders cannot supply the required number of workers, plants attempt to draw on previously untapped sources of skills in other seniority districts. The effects of the adjustment process upon labor productivity and other costs of production may then be distributed quite widely throughout the plant.

A change in the plants' hiring standards for entry jobs is the analogue of the change in promotion patterns within the plant. The increased rate of promotion occasioned by technological change may produce changes in hiring standards even though the entry jobs are not themselves affected by the innovation.

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[78] Even in the extreme case, when the impact of an innovation is apparently confined to the destruction of jobs, the modifications of equipment required to absorb the tasks of the destroyed jobs will involve some adjustment in maintenance skills.

[79] The latter adjustments are constricted by customary law, but if the number of new jobs opened up is so vast that traditional promotion ladders cannot supply the required workers, deviations from them are generally permitted.

Because changes in promotion patterns frequently involve an increase in the amount of "learning" required on the expanding jobs, they are often accompanied by changes in the student-teacher relationship.[80]

The complexity of these adjustments helps explain why it is difficult for engineers to forecast the costs of labor used in a new technology. Cost estimates are particularly problematic where adjustments involve a change in promotion patterns. Part of the cost of manning the new equipment is then borne by the divisions of the plant from which the labor supply is transferred. These divisions are often quite remote from those in which the new technology is introduced.

Moreover, the engineer may be unable to foresee the adjustment patterns, let alone estimate their costs. In several cases discussed during the interviews the new sources of labor supply had been suggested, after the technology had been introduced, by line supervisors. The latter benefited from the immediate stimulus provided by the skill shortage and utilized operating experience to which the engineers themselves did not have access. The engineers' difficulty in predicting the sources of labor supply may be overcome in the future by the use of computers to analyze and construct optimal promotion ladders. Several plants were experimenting with this technique. On the other hand, one plant was using the computer to search its entire employee records for workers with skills needed on jobs for which trained labor was in short supply. This caused the adverse effect upon productivity of drawing experienced operators from their usual jobs to be even more widly spread throughout the plant and increased the difficulty of predicting the cost of adjustment.

The complexity of the processes through which the plant adjusts to new jobs suggests that one should be cautious in drawing conclusions about a technological innovation from the initial operating experience. The adjustment process will color virtually every variable used to characterize the technology. The process of on-the-job training and the adaptations in the teaching function will distort the labor requirements of the technology. In general, both the total labor force and the ratio of unskilled to skilled workers will be greater than that which will prevail in the longrun. The training period will also involve unusual rates of materials consumption and machine downtime.

Changing promotion patterns may reinforce these effects if the newly promoted workers are inherently less capable than the workers originally employed in the expanding job categories and are therefore never able to achieve the same level of efficiency.[81] Since it should be possible to find more capable workers when individual vacancies occur, efficiency will normally rise as the original employees are replaced. In most plants, however, workers can be replaced only when they voluntarily leave the job. Consequently, a change in promotion patterns will generally have longer lasting effects than will training procedures.

On the other hand, it would also be misleading to judge the longrun impact of new technological change on the basis of previous experience with similar technologies. Some of the modifications in the student-teacher relationship and in the sources of supply which accompany the introduction of new technology will be required permanently to maintain the higher levels of employment in the expanding job categories.

Adjustment to new jobs. When technological change creates new jobs, there is no reservoir of experienced operators to serve as teachers. It would therefore appear that on-the-job training is impossible. This does not seem to be the case. The processes of design, experimentation, construction, installation, start-up, and debugging substitute for the production process as learning situations. Operators and maintenance personnel are withdrawn from production to participate in one or all of these phases of the innovative process. Their participation is not contrived solely for the purpose of skill development, but is necessary to the innovative process. When the plant's own operators and maintenance personnel are not available for the work it must be performed by someone else. The term "on-the-job training" can therefore be applied as appropriately to learning in the process of innovation as it is to learning in the process of production, and the former has the characteristics ascribed to the latter in the preceding section.

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[80] Changes in promotion patterns, however, will not always involve a change in this relationship. The employees on a promotion ladder frequently acquire technical capabilities required by higher level jobs and simply lack the practice that makes for speed and efficiency. When this is the case, no "teacher" is required.

[81] This effect of changes in promotion patterns may be strong if the plant is obligated to retain employees *displaced* by the change.

The process of innovation and installation has one advantage over the process of production for the development of skills—a wide range of operating problems and difficulties is encountered in a very short space of time. When the equipment is in regular operation, the same range of problems might be encountered only over a period of years, or perhaps not at all. For this reason, plants often find it advantageous to have relatively inexperienced employees participate in the installation and debugging of equipment, even when other employees, experienced with similar models, are available to do the job or when a vendor has his own crew for these purposes. Thus, training in the process of installation is not necessarily confined to new equipment.

On-the-job training in the process of innovation is closely linked to what was termed, in the preceding section, "the empirical base of manufacturing technology." To facilitate experimentation, engineers frequently attempt to simulate operating situations in their workshop. Occasionally they actually develop the innovation on the plant floor. The approximation to reality is furthered by the borrowing of hourly employees from the operating and maintenance departments to operate and repair the equipment during the developmental phase. This, in turn, extends the opportunities for these employees to learn their new jobs. James R. Bright's studies in fact suggest that a realistic simulation of operating conditions is so critical to the process of innovation that, when it is neglected, new equipment requires extensive rebuilding in the course of installation and start-up.[82] This implies that training opportunities curtailed by a failure to use operating employees in the developmental stages of new technology would be automatically balanced by an extension of training opportunities when the technology is installed.[83]

Despite mechanisms of this sort, the development of new job skills becomes more complex when the job incumbents do not participate directly in the innovative process. Their participation appears to be limited most frequently in two situations: when the major part of the development and construction of the new technology occurs at a location geographically remote from the plant—in a vendor's establishment, for example—and when the innovations constitute a radical break with existing technologies.

When the development of the new technology occurs far away, direct participation of the plant's own employees is inhibited by their reluctance to move temporarily to the place where the innovation is being produced and by the cost of transporting and maintaining them there. In most of the plants involved in this study, participation was further constrained by the rules or customs requiring that hourly employees who went out of town on company business be paid their regular hourly rate—and sometimes premium rates—for all hours away from home.

However, much of the work performed by hourly employees in the design and construction of equipment is essential; it must get done. And those who do it learn the new jobs in the process. They then become the first generation of incumbents on the new jobs, passing on the new skills to regular operators and maintenance craftsmen on the job. Very frequently, this first generation consists of a vendor's craftsmen, who work with the plant engineer in the developmental stage. When they install the equipment on the customer's premises, they also act as "teachers" to the customer's employees. Most of the firms in the study insisted that their contracts with vendors require that the vendor retain responsibility for the new equipment until it is operating satisfactorily. This tended to insure that the transmission of skills from the vendor's to the customer's employees would take place. If the customer's employees did not acquire full competence before the vendor's employees left the premises, arrangements were generally made for the customer to recall the vendor in emergencies.

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[82] James R. Bright, *Automation and Management*, (Boston: Harvard Business School, Division of Research, 1958), pp. 123–131.

[83] As argued earlier, the direction of causality between the on-the-job training and the empirical base of technology also runs the other way.

During the transition period responsibility is often shared between customer and vendor. In one case, for example, the customer's employees were not fully trained but could handle the equipment when backstopped by the vendor's representatives. When trouble developed, the customer communicated the problem to the vendor over the phone: the vendor gave verbal instructions which the customer's employees carried out. Here, as in on-the-job training for older jobs, there is a temporary pattern of substitution—the substitution of low-skilled employees of the customer and capital equipment (the telephone) for the more highly trained employees of the vendor—which also serves as a learning situation in which the low-skilled employees are eventually transformed into high-skilled labor.

The transmission of skills between vendor and customer need never be completed. Frequently the vendor maintains the customer's equipment on contract. When this is the case, the separation of vendor and customer is not a hindrance to the development of new skills since the vendor alone requires these skills.

The extreme pattern in the development of a new job family occurs when the engineer serves as the first generation of workers, passing on the required skills to both operators and maintenance men only after the innovation is virtually complete. This pattern usually prevails when the technology requires radical departures from existing techniques as did, for example, computer technologies, numerically controlled machine tools, and automated equipment. Because it is in such cases that labor supply bottlenecks allegedly develop, the pattern deserves examination.

There is a large discrepancy in educational background between the engineer and those who ultimately work with the new equipment he is developing. Consequently, when the engineer serves as the first generation on a new job, it is extremely misleading to draw conclusions about the actual requirements for performing the job from the early operating experience. Such a mistake is not likely when the decline in formal qualifications takes place wholly or largely between the first and second generation of incumbents. The decline may, however, be prolonged over several generations.

A prolonged decline can occur because the plant has very little idea of what skills are actually required to perform a new job that is radically different from any that preceded it. The engineer who designs and builds the equipment is clearly qualified to do the job. Presumbly something short of a complete engineering education will suffice to equip a man to perform the work. But it is very difficult to know the minimum requirements precisely.

The problem of identifying the minimum requirements is made more difficult by incomplete understanding of the relationship between job performance and the individual components of a formal educational curriculum. Thus, even if the requirements for a job were to consist of certain components of the engineer's own education, the task of identifying them would not be an easy one.

Moreover, in the course of transferring the job, two additional changes take place that make the engineer's own education a very poor guide. First, the methods of performing the job change, and they change in a rather unpredictable way. Many manufacturing processes are monitored by the sound, smell, or feel of the operating equipment. The operator, for instance, can tell by the "feel" of the equipment whether it is running smoothly and, if not, where the trouble is. In chemical processes, he sometimes tastes the product. Such "skills" are developed over time through continual association with a process. The designing engineer, in contrast, generally monitors a process through a more formal procedure involving blueprints, designs, and special instruments. The technique of monitoring by "instinct" is not necessarily inferior to the formal procedures of the engineer. It may even prove more efficient, since it enables the operator to anticipate trouble and diagnose the source quickly. This alternative, "instinctual" technique takes time to develop, however. Indeed, it may develop over several generations. The engineer, because he is accustomed to operating in a more formal manner, may be unable to foresee any alternative way of doing the job.

Secondly, changes often take place in educational technology which give people with much less educational achievement than the engineer access to critical job skills. These changes, like those in job technique also occur in an informal and unpredicable way. It is easy to find examples of such changes in the formal educational curriculum: the discovery that set theory can be taught in grade school has led to the new mathematics. Similarly, in the Second World War it was found that illiterate recruits could be trained as truck drivers by shortcutting the usual literacy requirements and training the men to "read" only those words and symbols encountered on the specific routes to which they would be assigned.[84] Informal examples of such innovations in educational technique are more difficult to come by. But in trying to communicate complex ideas to less broadly trained technicians, the engineer will inevitably find methods of circumventing gaps in his students' formal background, just as the economist finds it possible to teach sophisticated economic theory without calculus. The development of these new techniques may span several generations of job incumbents. Major gaps in formal educational achievement which the engineer cannot overcome may be bridged by less sophisticated workers who learn the job from him. Thus, for example, a technician trained by an engineer may be able to train a grade school graduate.

Changes in the way of doing the job and in the ways of acquiring the necessary skills can take place without a change in the design of the equipment. However, the equipment itself is often modified to facilitate these changes. Many of the minor innovations developed by the operator and his supervisor arise for this purpose. Like the slowly changing techniques of education and job performance, these minor modifications in the equipment evolve over time. They are stimulated by actual operating situations and possess a dynamic of their own in which one modification creates the environment which stimulates the development of another.[85] It is thus difficult to foresee the kinds of changes which will be most desirable, and this is particularly so for the engineer. Having his own way of performing the work, he often cannot conceive—in the abstract—of any need for change.

In situations where all three types of change take place simultaneously, it, of course, becomes extremely difficult to find realistic examples that illustrate each type individually. Taken together, however, the changes are responsible for what is rapidly becoming the paradigm of an unforeseeable decline in educational qualifications for new technologies: the jobs associated with the computer. The requirements for these jobs, which originally included sophisticated mathematical skills, have now been substantially reduced through a combination of adjustments in the productive technology, the development of simple program languages like Fortran, and changes in the methods of teaching these languages. These changes were cited in all of the plants visited which used computer technologies.

To summarize, the predominant method for developing labor force skills in the plants surveyed was internal training on the job in the process of production. Although technological change disrupted normal training procedures, it was accommodated through a similar process of on-the-job training. When the effect of the change was primarily a redistribution of workers among existing jobs, training continued to take place in the process of production, but promotion procedures and teacher-student relationships were modified. When the change created jobs not previously known, the skills required by the new jobs were developed in the process of innovation. When the employees who normally would man the new technology did not participate in the process of innovation, the job was initially performed by personnel who did participate and who then, in the process of production, trained the workers who ultimately manned the equipment. When the requirements of the new jobs were radically different from those of preexisting jobs, equilibrium requirements were reached only after several generations of successively less skilled incumbents had been trained on the job. The decline in the job requirements was made possible by changes in the technique of "teaching" the job, by changes in the way the job was performed, and by minor modifications in equipment, all of which were stimulated by the training process.

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[84] This information was provided by Mr. Andrew Brest who developed several such programs for the Army during the war.

[85] This appears to be part of what Arrow means by "learning by doing." See Kenneth J. Arrow, "The Economic Implications of Learning by Doing," *The Review of Economic Studies*, Vol. XXIX No. 80, July 1962, pp. 155–156.

To the extent that skills required by new technologies are developed in the process of innovation and production, absolute bottlenecks (workers unemployed but unqualified for vacant jobs) will be avoided. Any imbalance between the skills of the labor force and the skills needed for the jobs will be felt in an increase in production costs caused by the use of inexperienced labor. These increased costs present a problem to the plant because they are indirect and therefore difficult both to forecast and to control. That they can also present certain social problems will be discussed in the next section. But these problems are short-run in character, symptomatic of an adjustment process which is taking place, and consequently are of much less importance than those created by absolute structural bottlenecks.

Although on-the-job training was the predominant technique in the plants visited, it was not the only method used to develop the skills of the labor force. In addition, the plants conducted a number of formal training programs and hired workers trained in other institutions. These training processes may produce structural bottlenecks. Formal training off the job may leave jobs vacant while the labor force is being trained. Additional problems are created by the necessity of coordinating the training with the needs of the plant. It is therefore necessary to explore formal training procedures in some detail.

Formal Education

Formal education within the plant. Many of the training programs in the plants surveyed proved, upon investigation, to be merely formalized on-the-job training, giving the trainee exposure to the variety of situations he was likely to encounter when working on his own. The programs did not change the basic character of the training process. In one plant, for example, trainees learning machine repair were rotated through various departments of the plant. In another plant which had a plant-wide maintenance department, the maintenance foreman tried to assign trainees in compliance with a formal training schedule which listed the various operations to which the trainee was to be exposed in an order determined by the skills involved. As noted earlier, seniority districts and promotion ladders often performed the same function.

A variety of formal classroom programs was also encountered in the study. These ranged from simple orientation programs to training in verbal and mathematical literacy. At the extreme were several plants which gave instruction in higher mathematics and electronics. The programs that were examined in detail followed a set pattern. A typical one, conducted by a vendor for his customer's personnel, consisted of a 2-week course of instruction in higher mathematics and electronics. The material was oriented towards the vendor's equipment, but a good part of it is normally covered in college or even graduate classrooms. The vendor recognized that much of the material was above his students, but he expected them to emerge from the course with enough vocabulary so that they could describe equipment difficulties to his employees and receive verbal repair instructions over the phone. A large part of the material which the students did not understand initially would become clear on the job. At that point the program's graduates would have reached a level of sophistication approaching that of the curriculum, and would then be able to train their own replacements. This program involved a special set of problems that are not likely to arise when the plant originates its own programs. The vendor was compelled to accept any students his customer sent, which meant that he was unable to screen students in advance and consequently had an exceedingly heterogeneous student body. The basic features of the program, however—a sophisticated curriculum taught in a brief period and designed to supply a framework for further training on the job—were common to in-plant classroom programs as well.

In general, there was much less formal classroom training than one might expect. It appeared to be the preferred training technique only for the orientation of new employees to plant rules and procedures. The orientation was normally conducted by the employees' foreman, but was arranged for a large group when the number of new employees was large. Instruction in specific jobs, even in periods of rapidly expanding employment, was given on the job wherever possible—and the companies in this study went to great lengths to insure that it was possible. When four old plants were consolidated into a single plant at a new location, the company offered extremely attractive inducements to persuade employees to move with the plant so that they could later train new employees on the job. And the skills initially underrepresented among the transferred employees were taught to them on the job before they moved. Other companies managed to accomplish much the same thing through temporary transfers of experienced personnel to new plants. Companies which are too small to find these procedures feasible were underrepresented in the sample, but the few small companies which were studied paid special attention to the availability of experienced labor in selecting plant locations. The importance of an initial supply of skilled labor to train new employees is underscored by the problems of one small company which opened a new plant in a small town. The company had extracted a promise from the local community that its plant would be the only one of its kind in town, and this promise had been the deciding factor in the choice of the location. But the community reneged, and another plant in the same industry opened two months before the company was scheduled to begin its new operation. The opening was consequently delayed, and took place only after the planned wage level had been revised upward substantially to enable the company to hire an initial complement of skilled workers. In this crisis the plant did not consider alternatives to on-the-job training by experienced operators. These examples and other comments made during the interviews support the point made earlier—for many jobs, the required skills exist only as an oral tradition, passed from one generation of operators to another. And the cost of abstracting these skills so that they can be taught more formally is so great that it is not even considered.

Formal education outside the plant.[86] In the firms included in this study, the role of formal education in the development of skills was obscured by the use of formal educational achievement as a screening device in the employment of new personnel and, to a lesser extent, in promotion. Firms imposed educational qualifications for employment because they believed that these qualifications would select a group of candidates who would perform well on the job. They knew surprisingly little, however, about the relationships between the formal educational curriculum and job performance. At best, the hiring standards were derived from crude and unusually intuitive or "horseback" correlations between educational attainment and performance. One large firm was beginning to make these correlations more formally with the aid of a computer. It was apparent that in many cases educational attainment served as a proxy for such traits as reliability and learning potential. When candidates possessing the preferred educational qualifications were not available, the plants used more elaborate (and more expensive) screening devices to select candidates from lower educational groups.[87]

During the interviews, a sharp contrast emerged between the plant attitudes toward education in basic industrial habits and skills, on the one hand, and vocational preparation, on the other. Plant personnel evinced very little interest in the specific content of the general educational curriculum.[88] Management's preoccupation with the length of time that candidates have spent in school is symptomatic of this. This is not to say that they are unaware of differences in the content of the curriculum. They were particularly sensitive to differences in the quality of the same number of years of education in the North and South. But they tended to measure quality by such indicators as teachers' salaries and the physical plant of the school system. The debates about the content of education which have shaken the educational establishment in recent years (the new mathematics, the content of college education courses) were not of interest.

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[86] In relation to the material developed in this section, see National Manpower Council, *Improving the Work Skills of the Nation, Proceedings of a Conference on Skilled Manpower* (New York: Columbia University Press, 1955), especially pp. 58–82, 130–148, and 179–192. These pages report the conference discussion. Many of the participants were industrialists and their comments parallel those made by the respondents in the present study. They are particularly interesting as they relate to an earlier period of tighter labor markets. See also, National Manpower Council, *A Policy for Skilled Manpower*, (New York: Columbia University Press, 1954), pp. 94–114.

[87] This point emerges clearly in National Manpower Council, *A Policy for Skilled Manpower*, pp. 95–105.

One cannot attribute this apparent lack of interest, however, to any lack of involvement in the educational process, for the plants did provide training in general mathematical and verbal skills when this was required and unavailable outside the plant. One company gave instruction in basic literacy to the entire labor force of one of its plants in order to facilitate the introduction of a new, automated technology. In several other plants advanced algebra and calculus were being taught to facilitate training in electronic maintenance. It has already been suggested that these programs did not simply reproduce the basic school curriculum but abridged it in a variety of ways. If the formal educational curriculum is viewed as standard, this represents a substantial amount of innovation in educational technique, much of it on an ad hoc basis.

The fact that general education programs are conducted in the plant suggests two conclusions: First, absolute supply bottlenecks are not a meaningful concept—at the most, the bottlenecks are economic. Second, the school curriculum is a poor guide to the minimal cost and time necessary to provide scarce skills. Both conclusions are supported by the experience in overcoming shortages of skilled labor during World War II and the more recent European experience with poorly educated immigrant labor.

This is not to imply that the general education provided by the school system makes no contribution to the development of manufacturing, production, and maintenance skills. It develops literacy, industrial skills, and what were called earlier nonskill traits (i.e. habits of behavior and thought such as reliability, honesty, and punctuality). The very existence of plant training programs indicates that formal educational qualifications are more than a screening device—the plant can apparently compensate for a lack of formal education, but it must assume an additional cost burden in doing so. Moreover, in-plant instruction, even in "general" skills such as reading, writing, and mathmatics, is far narrower than formal schooling; it can be so narrow that the worker is unable to "read" anything but the instructions, or do any but those calculations needed in his job. Adjustments in the labor force may be less costly overall and less painful for individual workers if they receive broad training in these skills at school.[89]

It is important to recognize, however, that formal education is not the only process outside the plant through which productive attributes are acquired. The habits of behavior and thought, and the general skills important in manufacturing work, which the school appears to teach are central to the whole operation of the industrial culture of which both the school and the manufacturing plant are a part. They are carried on and developed by a number of other social institutions and situations besides those of the school system. And, particularly with regard to what were called earlier "nonskill" traits, it is debatable whether the school actually teaches them or simply depends upon them. Certainly it is easier for the student to remain in school if he possesses these traits.[90]

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[88] Ibid.

[89] On the role of formal education in skill development, see *Getting Hired, Getting Trained*, (Washington: National Committee on Employment of Youth, 1965), pp. 19–44. Also National Manpower Council, *A Policy for Skilled Manpower*, pp. 136–158.

[90] It seems reasonable to credit the school system with some role in developing even the more amorphous habits of behavior and thought. The Deutsch experiments with the early education of children from underprivileged homes—which, in this case, means homes farthest removed from the mainstream of the culture and from the habits it teaches—which provided the foundations for "Project Head Start" indicate that such habits can be taught in school. See Charles E. Silberman, *Crisis in Black and White*. (New York: Random House, 1964), p. 280.

Among the various facets of the general cultural environment, patterns of consumption may be particularly important in enabling the labor force to maintain pace with the skill requirements of evolving productive technology. To a very large extent consumption and production share the same technology. In a variety of subtle ways, the consumption goods with which people grow up and live facilitate the absorption of production skills. This relationship between consumption goods and productive skills is particularly apparent in the case of do-it-yourself consumption projects and in the development of basic mechanical and electrical skills through the home repair of consumer durables like automobiles and television sets (although several plants expressed disappointment with the "gadgeteers" whom they had hired as trainees for maintenance jobs). But a number of "skills," unrecognized as such precisely because they are so basic to daily life, are also acquired by consumption: the appreciation of the relationship between the light switch and the light, or between a dial and a machine speed, or the steering wheel and the direction of the car; the focusing of a TV picture; the acquired ability to sense when consumer durables are about to break down; the dangers of electricity; what it means to blow a fuse; what materials are highly flammable. Each of these "skills" contributes in one way or another to the absorption of productive technology.

The relative disinterest of the plants in the general education provided by the school system contrasts sharply with their attitude toward specific vocational preparation. Respondents from a number of plants mentioned programs conducted through the school system which were designed to meet the special skill requirements of technological change. In one case involving basic training for literacy the program was clearly a short-run one designed to overcome the immediate shortage. But the remaining programs were permanent, instituted to create a regular supply of graduates possessing the required skills. They took a variety of forms. Two of them, designed to supply craftsmen skilled in electronic maintenance, were revisions of the high school vocational program. They supplanted a training program which had previously been conducted in the plant. In several other cases, programs were developed in local community colleges to train technicians in the plant's somewhat specialized technology.

One pattern was common to these situations: the initial generation of personnel required by the new technology was trained in the plant, and in-plant training programs continued to meet personnel requirements for several subsequent generations. After the skill requirements and the methods of teaching them had been worked out in the early operation of the technology, the programs were moved out of the plant and into the schools. In this sense, they represent a longrun pattern of accommodation.

It is also characteristic of all these programs that they had been initiated by the plant, and were dependent upon it in so many respects that they appeared to be an extension of its internal training activities. Occasionally the plant supplied the specialized equipment required as well as the necessary teachers. It developed the curriculum. Frequently the student body was drawn from among its own employees. In return, the school system provided classroom space and faculty compensation. To speak only of direct contributions, however, is to understate the degree to which the plants absorbed the cost of these programs. They provided indirect support through tax payments in the case of the public school system, and through voluntary contributions in the case of community colleges. Direct cooperation between the school and plant was further buttressed by the presence of some of the plant's managerial personnel on the local school boards and on the boards of trustees of nongovernmental educational institutions.

The responsiveness of the schools to the plants' needs is augmented by the competition of States and local communities for industrial establishments, a competition whose principal weapons are tax concessions and social services. The companies in the survey reported that the "attitude" of the local community on these issues was a factor in their decisions concerning plant location, and one company had made a commitment to one locality conditioned upon revisions in the public educational program.[91]

These relationships between plant and school suggest that there are decentralized institutional mechanisms, in many respects analogous to a competitive market, operating to coordinate the specialized vocational training provided in schools with the skill requirements of plants.

These mechanisms do not produce complete coordination between skill requirements and educational programs, although coordination is no doubt greater in some communities than in others. One might hypothesize that in large cities, where the school system is far larger than any single plant and where its very size reduces its flexibility to accommodate individual plant needs, little adaptation of this kind takes place; the schools, at best, respond only to very broad trends in industrial requirements. Nevertheless, the plants with the closest relationship to local educational institutions were located in a midwestern city of 500,000 people.

The schools provide one channel linked directly to the firm through which adjustment to changing skill requirements take place. Another direct linkage is that between the customer plant and the vendor of equipment.[92]

The complex of training programs conducted by the plant, the vendor, and the schools recalls Gary Becker's distinction between general and specific training,[93] originally developed to explain the distribution of training costs. Becker hypothesized that the cost of general training would be transferred by the firm to the worker who received the training, but that the cost of specific training would be borne, in part at least, by the firm. This distinction was not very helpful in understanding the process of adjustment within the plants studied. The distribution of costs was not an explicit factor in deciding whether training was to be undertaken or where it was to be conducted. In most cases, plant programs were developed in direct response to pressing skill shortages, and little attention was given to costs at all. The degree to which costs could be deliberately shifted, moreover, was limited by the difficulties of identifying what they were. The problems in identifying the costs of on-the-job training have already been noted. The cost of vendor programs was frequently buried in the cost of capital equipment. The costs of school programs financed by the plant were generally paid either through local taxes or from a "community relations" budget. The local tax bill was treated in all companies as a fixed cost of the plant. Community relations budgets were usually established on the corporate level; on the plant level, they were treated as "surplus funds," used to finance projects directly useful to the plant if these would be justified as generating community good will but otherwise contributed to charity.[94]

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[91] On a much lower administrative level, school responsiveness is reinforced by the tendency to judge the performance of individual schools and some school administrators by their success in placing students after graduation, a success which is largely dependent upon the attractiveness of the students to the local plants.

[92] See supra, pp. 122–125.

[93] Gary S. Becker, *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*, (New York: National Bureau of Economic Research, 1964), pp. 7–28.

[94] The interview material suggested several other points not directly relevant to the problem of this study, but of interest in evaluating the distinction between general and specific training and the hypotheses relating to it:

1. Most general education conducted in the plants studied was temporary, designed to overcome short-run shortages in a tight labor market or created by the introduction of a new technology. The degree to which these costs could be shifted through wage differentiation was limited by the fact that the rules governing wage payment required that workers holding the same or similar jobs be paid the same basic wage because workers receiving general education in temporary plant programs often worked on jobs similar to those held by workers who received their general training outside the plant.

2. In the short run, in fact, it appeared that the cost of specific education was more likely to be transferred through wage differentiation, for such training is more likely to occur on the job, and in on-the-job training, incentive payments systems (if they exist) automatically reduce earnings during the learning period.

3. The cost burden of training programs which are a normal part of plant operations may, however, be distributed between the firm and the worker in accord with the Becker hypothesis. When training programs are permanent, workers holding similar jobs are all likely to have been trained in the same manner. Moreover, in the long run, the plant has a greater opportunity to design the payment system to affect the desired distribution of costs. Several managers expressed concern during interviews about labor turnover among specifically trained workers and indicated that it was a factor in wage setting and promotion.

4. The distinction between general and specific training does not appear to explain the location of training. (Becker, it

The Role of the Market in the Development and Distribution of Job Skills

Thus far, exclusive emphasis has been placed upon adjustments of labor force skills which take place either within the plant or within institutions directly linked to the plant which respond to the plant's initiative. Little has been said about adjustments which occur outside, in an indirect response to plant requirements, as these requirements are indicated by market parameters. The emphasis has been deliberate. Internal adjustments and adjustments in *direct* response to the plant's needs appeared to be the predominant mode of adaptation to technological change. They were the chief means of overcoming incompatabilities between the attributes of the labor force and job requirements which developed for other reasons (e.g. a tight labor market during the upswing of the business cycle) as well.

There were, however, a few jobs in which internal adjustments were apparently not feasible, and interfirm transfers through the market appeared to be essential to skill development. Two job categories for which this seems to be the case were encountered in this study: Operating jobs in an ethylene cracking plant, and machine tool set-up and repair jobs in an automotive parts plant. Both categories share a common set of characteristics. They require broad training in a given technology to enable the employee to handle situations which occur rarely but which are likely to involve substantial costs if handled incorrectly. Neither of the two plants was able to give this broad training internally. Both produced long runs of standard products, and the equipment was seldom modified (in the ethylene plant, under normal operating conditions, equipment was never modified). There was, therefore, little opportunity to take the equipment apart and teach the employee how it worked. Instead, the plants hired trained people who had acquired the relevant understanding in other plants where a greater variety of experience was available. Ethylene cracking operators were drawn from multipurpose cracking plants, automative machine tool repairmen from metal working job shops.[95]

These two cases are of some interest. When plants cannot train internally and the traditional pattern of skill transfer is disrupted—because of a disproportionate expansion of the industry receiving the skills relative to the industry producing them, for example, or a technological change in the producing industry—absolute structural bottlenecks may arise. A disruption of this kind appeared to have occurred in the ethylene industry, but ethylene plants seemed to be using untrained or inadequately experienced operators and accepting the risk. Although a potential source of bottlenecks, interfirm transfers did not appear to be a serious problem at the time of the study. And the small number of jobs in the sample which required such transfers suggests that serious bottlenecks arising from this source are unlikely.[96]

(Footnote 94 Continued)

should be added, did not use the distinction for this purpose). Plants and vendors conducted some very general training programs; some training in technology specific to a single plant was conducted in the school system.

5. The distinction may nonetheless explain the distribution of training costs, if not between the plant and the worker, at least between the plant and the community at large. Direct contributions by the plants to schools for specific education appeared to be far greater than direct contributions for general education.

[95] An alternative pattern which has been suggested but not encountered in this study is the transfer of trained labor from large firms, which can afford to support unproductive trainees, to small firms of only a few employees, where the cost of a trainee is an intolerable burden. Although the possibility of such patterns existing cannot be denied, they become less plausible when one recognizes that trainees pick up more complex skills while performing lesser skilled productive work. In job shops, for example, there may be a number of individual positions which can be learned relatively easily, and so long as there are at least four or five other workers, the unskilled trainee can be occupied productively while he absorbs the skills needed for other machines.

[96] As a practical matter, the patterns of skill transfer through the market may have their most interesting implications for wage setting. In a tightening labor market, for example, wage pressure may emanate from small firms who are attempting to hold their trained labor and who are unencumbered by the elaborate internal wage structure and the fears of the leverages individual wage increases will have upon it which inhibit wage adjustments in large plants. Large firms may then be forced to respond in order to off set the flow of trained labor which the small plants stimulate. On the other hand, the multipurpose cracking plants were often as large as the ethylene cracking plants to which they supplied trained labor.

Other Equilibrating Mechanisms

The adjustments through training outlined in the previous section will not by themselves insure a smooth adjustment to the changes in job content occasioned by technological innovation. Some innovations may generate jobs which either impose intolerable training adjustments upon the firm or which the existing labor force cannot be trained to fill. Conceptually, the problem may be viewed in terms of a spectrum on which the costs of training labor are measured ranging from zero on the left, where the jobs on the new technology do not differ from those on the old, to infinity on the right, where the new jobs differ so radically that labor for them cannot be trained at all. If, as appears to be the case, the cost of training is not a factor in the decision to select a technology, then new jobs should be randomly distributed over this spectrum, in which event structural bottlenecks would be as likely to arise as not. The fact that such bottlenecks do not occur indicates that there are other mechanisms, inherent in the process of technological change, which skew the distribution of new jobs toward the left. Several such mechanisms have been alluded to earlier and are briefly recapitulated in this section.

The Continuity of Technological Change

The process through which technological innovations are developed tends to produce a gradual evolution of technology and to inhibit radical, discontinuous jumps. The fact that direct observation of current techniques is an important source of innovations, and that many of these innovations involve only direct modifications of existing equipment often designed and instituted by the operator or his supervisor, tends to produce evolutionary rather than radical change. The empirical base of technology has a similar effect. It forces the engineer to go directly to existing processes when seeking innovations, and new ideas, therefore, tend to be developed within the context of the prevailing technology. The importance of experimentation in design and development also means that new developments are more likely to derive from current technology than from some point at the forefront of scientific understanding. A degree of continuity is also imposed by the requirement that manufacturing technology "work," for the closer a new idea is to the technology already in operation, the more faith the engineer should have in its feasibility. The risk of failure inherent in radical departures from existing technology may be overshadowed by the prospect of substantial gain, but unless the latter consistently balances the former, new technologies will tend to be related to those which already exist.

The continuity of technology does not insure continuity of job skills. One technological change observed relatively often in the study was increase in the speed of packaging equipment. Plants apparently expected this equipment to run increasingly fast throughout its life, and the theoretical maximum speed was almost continually being overcome by one modification or another. As the speed increased, however, operating jobs were eliminated, largely because individual operators could no longer keep up with the machine. They were replaced either by mechanical gadgets or by electronic monitoring equipment. Even in this case, however, there was a certain continuity of skills. Skills needed to repair the mechanical gadgets, although not the electronic monitoring equipment, resembled traditional skills. Moreover, part of the requisite repair skills involved simple adjustments, often no more than a realignment of a package which had fallen out of line, which the old operators could perform. It appears, therefore, that the continuity of technology will at least skew the distribution of new jobs toward those already in existence even if it does not prevent the creation of some jobs which require major adjustments in the labor force.

Moreover, several of the factors which foster continuity of technology also directly foster continuity of job skills. Innovations developed by the supervisor and the operator will usually be tailored automatically to the abilities of current employees, as will innovations developed through experiments in which line operators and maintenance personnel participate.

The Tendency for Technology to Cluster

Two factors inherent in the process of technological change suggest that technologies are likely to "cluster" in the economy. The first of these is the standardization of parts. A number of relatively diverse technologies encountered in the study were built with standard, mass-produced parts. The technologies had frequently been designed to take advantage of the existence of these parts and, in fact, were often not economically viable without them. In one extreme case, an engineer reported that the automated assembly equipment which he was building at the time of the interviews had been technically feasible fifteen years earlier, but had become economical only in the last three years when the parts of which it was composed began to be mass produced.

A second factor in the clustering of technology is the network of communications through which new ideas are disseminated: trade magazines, vendor salesmen, trade shows, and the direct observations of engineers as they move through their own plants or other plants in the economy. This network of communication directly creates clustering, for engineers attempt to imitate innovations developed elsewhere. It also produces clustering indirectly, because the knowledge that a given technology works encourages engineers to pursue lines of research closely connected with it.

By itself, the clustering of technology does not insure a similarity of skills between old and new jobs, but if continuity of technology skews the distribution of new technologies toward those already in existence, clustering will reinforce the pattern.

Clustering also smooths labor force adjustment to technological change, for it increases the number of situations in which workers have an opportunity to absorb new skills through "osmosis," while working on other jobs in the plant and in other sectors of the economy. Moreover, many of the factors which produce clustering of manufacturing technologies undoubtedly produce a degree of harmony between trends in manufacturing technology and trends in consumption technology and in the technology of producers' goods in the service industry with which consumers come in frequent contact. Thus, to the extent that workers absorb part of their productive skills through consumption, the clustering of technologies insures that they will continue to do so.

Checks Upon the Rate of Technological Change

Finally, there are several mechanisms which serve to check the rate of technological change itself and thus to limit the amount of adjustment the plant must make at any one time.

Of these mechanisms, the most important encountered during the study was the role of engineers in the training of blue-collar workers. The engineer's withdrawal from the innovative process to train blue collar workers in the operation and maintenance of equipment he has designed effectively slows, and can even halt, further technological change. The strength and duration of this effect, moreover, varies directly with the degree of difficulty workers encounter in adjusting to new jobs.[97]

This effect caused some concern in several of the plants visited. In one plant where equipment was designed and constructed close to the plant floor, the effect continued even after regular maintenance crews had learned to repair the new equipment because the engineers were still able to repair it faster and were therefore continually being diverted from their design activities. Management felt that the sacrifice in further technological development was not justified by the reduced downtime, and was instituting strict disciplinary procedures at the time of the interviews to insulate the engineering staff from production problems.

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[97] A similar effect is evident in the comments of a corporate executive reported by Heller:

> Perfecting a layout involves a minimum amount of managerial and technical work that you can't escape. You have to handle expansion projects in series because you simply don't have the necessary number of men of the required caliber around to keep up a double-up pace. If we had gone ahead too fast, we would not have been able to get either proper supervision or the technical brains required to get the bugs out. Also, we have to keep production up during the change-overs as long as markets are strong or we will be losing part of our market. So it's the scarcity and costliness of brains that slows down our rate of investment.

Walter W. Heller, "The Anatomy of Investment Decisions," *Harvard Business Review*, Vol. XXIX No. 2, March 1951, p. 102.

In the longrun, of course, any single plant can expand the size of its engineering staff to compensate for diversions of this kind, but because technology tends to be both specialized and empirical, this is not always easy to do. The new engineer himself requires a period of on-the-job training before he can begin to improve upon unfamiliar technology. One plant found the rate at which new equipment was introduced to be entirely dependent upon the rate at which the few plant engineers who were skilled in the specialized technology could construct it.

Other checks upon the pace of change are undoubtedly present in mechanisms which lie beyond the purview of this study. Given the relative rigidity of wage rates and the fact that most adjustments to technology take place through changes in labor force skills, the short-run fixity of capital equipment will prove to be an equilibrating force. The rationing of investment funds within the plant will have the same effect.

7. CONCLUSIONS

The central theme of the present study is that differences between the skills and abilities of the labor force and the requirements of blue-collar jobs in manufacturing are reconciled through a series of instruments over which the employer exercises discretionary control. These instruments—recruitment procedures, training, compensation, and the like—exist because a number of functons conventionally identified with the market are internalized within the manufacturing plant. They constitute the alternative modes of adjustment to changes in both production techniques and labor market conditions.

Given these instruments and the apparent willingness of employees to effect labor market adjustment through them, persistent structural skill imbalances in the manufacturing sector appear unlikely. Indeed, this study suggests that the concern over the contribution of changing technology to the structural components of unemployment during the late 1950's and early 1960's has been largely unwarranted. The process of overcoming imbalances through these instruments, however, imposes certain costs upon the plant, which may in turn be translated into price increases. Such inflationary pressure appears particularly likely when the average quality of the externally available labor force deteriorates, as in the case of a tightening labor market, and is probably one of the factors responsible for the apparent trade-off between unemployment and price stability.

There is a similar inflationary potential in the process of adjustment to technological change. Two types of labor force adjustment are associated with such change: (1) the adaptation of workers to jobs created or changed by the new technology and (2) the adaptation of workers displaced by technological change to new employment. The costs of this adjustment should, in principle, be included in the calculation of the total investment expenditure, amortized over the life of the investment, and reimbursed by the savings it generates. When these costs are borne by the innovating employer, there is an incentive to treat them in this way. The innovating employer almost always bears the costs of labor force adjustment to new or changed jobs.[98] When the technological change displaces workers from the plant, however, he is able to transfer a portion of the total adjustment costs elsewhere in the economy. In such situations, part of the adjustment cost is absorbed by employers who are unable to anticipate them and who do not share in the savings generated by the technological change.

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[98] The employee too encounters costs, both direct and indirect, but these do not typically contribute to inflationary pressures.

Even for the innovating employer the costs of adjustment are hard to forecast. Many of the adjustment instruments create indirect costs which are difficult to identify and control. These difficulties, when reinforced by the uncertainties surrounding manpower requirements for new technologies, seldom allow the employer to fully anticipate adjustment costs.

Since, in a dynamic economy, technological change is continually taking place, a certain allowance for adjustment to it is built into the cost structure of the economy. Thus, in principle, technological change should increase costs only when the requisite rate of adjustment is greater than that required by the innovations of the immediate past. In practice, however, prices appear to be less responsive to cost decreases than to cost increases. Shifts in the distribution of costs among firms will therefore tend to produce inflationary pressures even if the total adjustment cost imposed by the technological innovations remains constant.

These considerations suggest several areas for further research. They indicate, first, the need for identifying the relationship between costs and prices to assess the impact of labor market adjustments upon national economic goals. Second, they underscore the importance of the distribution of changes in technology and the distribution of the adjustment costs among various sectors of the economy, a subject about which relatively little is known. Third, additional information should be developed on the nature of the interdependence between short run and long run instruments of adjustment and their contributions toward long run adjustment efficiencies. Fourth, research should be directed at the relationship between the displacement effect of technological change and the expansion of employment opportunities in the innovating plant, since the rules of the internal labor market frequently impose upon management the obligation to provide employment for workers displaced by technological change if jobs are available internally. Hence, the incentive to anticipate the labor force adjustments necessitated by their own innovations should be greatest in plants where innovation coincides with expanding employment opportunities.

While further research is needed in these areas, the present study permits some conclusions about the efficacy of the current labor market programs.

Federally Sponsored Training Programs

In analyzing federally sponsored training programs a distinction should be made among 1) general training in verbal and mathematical skills, 2) training in occupational skills specific to a single plant or industry, and 3) training in occupational skills common to many plants. Economic efficiency dictates that training should be provided by the plants which utilize it unless there are external economies or diseconomies associated with the training process. For training that is general to the economy or to a number of plants, both types of external effects may occur. First, there may be significant economies of scale in training which must be realized through mass training programs. Such programs are only within the training capability of very large plants or multi-plant associations. Second, if general training is provided by an individual employer, labor turnover may transfer the skills to another employer who has not contributed to their financing. For training that is plant specific, however, these external effects are negligible.

The case for Governmental programs to provide general verbal and mathematical training is strong. The usefulness of this training is not limited to certain industries, and it readily lends itself to identifiable programs which effectively utilize large scale instruction methods. Moreover, such general training has traditionally been supported by public funds. While plants do appear willing to supply some general training when such skills are unavailable on the external market, it is often excessively narrow. Employees, for example, may learn to read only those symbols and to perform only those calculations required by their present jobs. It does not, therefore, enhance labor force adjustment beyond the immediate confines of the plant and may even hamper further adjustment, should the narrow training encourage learning habits which later impede a worker's ability to acquire additional training. The provision of training for skills and abilities which are plant-specific, however, should rest with the plant. The structure of the internal labor market makes it difficult for workers outside the plant to gain direct access to many jobs utilizing these skills even if trained to perform them. A more important consideration, as argued in the text, is that training on the job is probably the most efficient method of instruction for most plant-specific skills. Where in-plant training is less efficient, institutionalized procedures already exist for transferring such training to equipment vendors or to the local schools.

Considerations of economic efficiency suggest that the plant should not only control the process of training in plant-specific skills, but should pay for it as well. Specific training yields, by definition, few external economies, and hence its costs should properly be absorbed in the plant where they will serve as an incentive to economize the scarce resources involved. If the inflationary consequences of plant financed training are significant, however, and the government can absorb the costs in a less inflationary manner, these economic considerations may be outweighted.[99] To reduce inflationary pressures of adjustment cost and to encourage the use of adjustment instruments which minimize the conflict with price stability, the government could support plant-specific training through a system of subsidies to employers. Such subsidization would have the advantage of preserving the existing efficiencies of employer control over training. The major obstacle to such a system is administrative, the training costs being largely indirect and difficult to quantify. They are probably not any more difficult to compute than depreciation allowances for capital equipment, however.

Training in more general occupational skills—maintenance mechanics, highly skilled machine operations, and the like—presents an intermediate situation between that of general literacy training and specific training. Like literacy training, when given in the plant it tends to be excessively narrow and may, therefore, yield unnecessarily high adjustment costs in the long run. On the other hand, like plant-specific training, it can be acquired on the job, and jobs utilizing such training may not be directly accessible from the external labor market. Given these hybrid characteristics, a system of Federal subsidization similar to that for plant-specific training, but designed to encourage broader training programs as well as to absorb training costs, would be most appropriate. If further research revealed that certain aspects of these skills could be more efficiently provided through formal out-plant programs, the subsidies might be combined with programs for direct training by the Government

Recruitment and Screening Programs

The same logic applied to the evaluation of governmental training programs can be extended to governmental manpower policies in the field of recruitment and screening. The Government should screen and recruit workers with characteristics of general interest to employers, while the cost of recruiting and screening for relatively plant-specific characteristics ought, unless there are significant economies of scale, to be left to private employers.

Again, however, other considerations may favor more extenive governmental recruitment and screening. For example, a number of currently disadvantaged groups may lack equal employment opportunity, not because they cannot perform the available work, but because they are difficult and expensive to screen. It has been suggested, for example, that a major contribution of the Manpower Development and Training Act training programs has been to screen groups of workers not possessing suitable formal educational qualifications, in order to identify a subgroup possessing such qualities as reliability and trainability which employers are actually using formal educational requirements to uncover. While this evaluation no doubt understates the contribution of governmental training programs, the programs probably make part of their contribution in this way. To the extent that they do so, a Federal screening program would be a less expensive substitute.

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[99] The additional problem of disturbing competitive cost relationships among firms which are crucial to the stability of the economy should also be recognized. In highly competitive industries, where labor costs are a high proportion of total costs, the subsidization of training expenses, for example, might provide new plants with a critical competitive advantage over established plants.

Coordination of Public and Private Programs

In developing Federal programs to facilitate labor market adjustment, care must be taken to establish suitable mechanisms for coordinating private and public activities. When training, recruitment, and screening take place either within the plant or under its direct auspices, the requisite coordination between the plant's needs and the adjustment process occurs automatically. When, however, some of the adjustment is provided by public institutions separate from the plant, the coordination between private needs and public activities may be less perfect. The inherent danger again is not one of persistent structural imbalances but of higher costs.

Many of the plants in this study developed contacts with local training institutions to encourage such coordination. These contacts involved the company deeply in the development of training curricula, especially in areas where it has a recruiting interest. If the Federal Government is to become more heavily committed to subsidizing adjustment, particularly if it undertakes to do so through programs conducted outside the plant, it should recognize the importance of decentralized control. The decision making power should reside with local authorities and, where appropriate, with individual employers so that the programs can remain sensitive to local market conditions.

Manpower Planning and Labor Force Adjustment

Finally, whatever types of manpower programs it selects, the Government must also identify those sectors toward which they should be directed. To do so, it must both appraise current manpower developments and forecast future trends. The internal labor market and the character of the adjustment process which occurs within it pose serious obstacles to this task.

Manpower data are currently collected in a series of categories that divide the numbers of the labor force into groups on the basis of socio-economic characteristics (e.g. occupation, educational attainment, industrial attachment, etc.). Manpower problems are then largely identified with imbalances between job requirements and the labor force structure as revealed by the distribution of workers among these categories.

The adjustment process, however, is continually modifying the distinctions among jobs and among workers which are implied by these categories. Required worker characteristics are changed through variations in hiring standards and screening procedures; the on-the-job training process involves both the transformation of the work force, and, in the short run at least, the redesign of jobs. The shifts in job design and required worker characteristics are so continuous as to defy any system of analysis dependent upon discrete categories. Moreover, in the case of technological change, the adjustment process involves innovations in these instruments which are virtually synonymous with discovery and hence are extremely difficult to predict. Present techniques of manpower planning therefore will, at least for blue-collar manufacturing jobs, inevitably underestimate the capacity of the private sector to effect adjustment.

One approach to manpower planning which circumvents these problems is to utilize indicative planning techniques analogous to those developed in France. Under this approach, manpower forecasts would be constructed by committies of personnel executives and industrial engineers joined by Govermental representatives, and perhaps representatives of educational institutions. The committies could be organized on the local, State, and Federal level to parallel the existing Governmental structure, but both industrial and geographical groupings are required. One advantage of this approach is that the participants in the planning exercise, because they are knowledgeable about current and prospective adjustmnts, can make allowances for them in developing and interpreting the data. Moreover, an important feature of French indicative planning is that it also works as a policy instrument in implementing the plan itself. A similar contribution may be made by indicative manpower planning.[100]

We have argued that a major Governmental concern with present adjustment processes should be the reduction of their costs. Incentives to minimize adjustment costs are already present in the plant's desire for profit and in the decentralized mechanisms coordinating plant skill needs and training curricula in public schools. What appears to be lacking are sources of information about alternative modes of adjustment.

Under present arrangements, each plant tends to discover, on its own, the changes in job design, promotion patterns, training techniques, hiring standards, and the like, through which labor force adjustment is effected. Experimentation to hasten the discovery process is inhibited within the plant by the difficulties of changing procedures once the labor force becomes accustomed to them and of identifying and controlling adjustment costs. Some sharing of experience among plants occurs through local organizations of personnel managers, various other community institutions, and through industry trade associations. But although the problems are in many respects analogous to those encountered in selecting new equipment, the channels for communicating information about labor force adjustments are in no way comparable to the trade magazines, exhibitions, and vendors which disseminate information about new equipment. Hence a pooling of information about adjustment techniques through the planning process may be sufficient to hasten the adjustment process and to reduce its costs. Once such systems for pooling information have been developed, the most effective deployment of the relatively small budget which the Federal Government now appears willing to commit to training efforts may well lie in expanding, through the subsidization of experimental programs, the fund of experience with adjustment techniques.

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[100] Because so much of the French economic policy is conducted informally and through implicit threats, the nature of the planning process is subject to several different interpretations. The proposal in the text was stimulated by Andrew Shonfield's discussion in *Modern Capitalism,* (London; Oxford University Press, 1965), pp. 121–175. But see John and Anne-Marie Hackett, *Economic Planning in France,* (Cambridge: Harvard University Press, 1963), and John Sheahan, *Promotion and Control of Industry in Postwar France,* (Cambridge: Harvard University Press, 1963). The Hacketts present a much more thorough discussion of the formal structure of the French planning process than does Shonfield. Sheahan places greater emphasis on the financial inducements to conform to the plan provided by the government.

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